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The Urgent Need for Coal

COMMON experience throughout the eastern and central sections of the country with reference to the coal problem is such as to indicate that the solution of the task calls for large statesmanship in Washington. In all directions we are urged to curtail, even to check, industries, if necessary to save fuel. The disposition is to suppress. Every news item breathes of drastic measures. Nowhere is there a ray of hope for better conditions. We get promises, conferences and priority orders, but little relief. Notwithstanding the testimony of the soft-coal producers and the added assurances from miners themselves that the present coal shortage is inexcusable so far as they are concerned, no one apparently has taken steps to do what seems most vital—increase the production of coal to a point commensurate with present demands. It is admitted that the solution of the immediate problem rests primarily with the railroads. Given sufficient cars, the miners and operators promise to supply the coal. Under the government control, hundreds of passenger trains have been taken off to make room for freight movement, and with what result every traveling man and shipper knows. The congestion remains. The public will endure from the government what it would not tolerate for one moment from the railroad companies. Power to remedy conditions is not lacking—the government has it all; but we are still looking for the man with vision and foresight to apply that power—for the Moses who is to lead us out of this wilderness. Surely there are men big enough, patriotic enough and willing enough to take charge of the whole question of coal production, transportation and distribution and co-ordinate this work effectively. The task demands the best brains available and the country will not be satisfied with less. Action is also necessary. We have dallied too long with a serious situation.

The Close of the Eighth Crusade

ON Dec. 10 last the official entry of the British and allied forces into Jerusalem was witnessed by the inhabitants. The procession is stated by General Allenby to have been entirely on foot, after the manner appropriate to pilgrims at the gates of the tomb of Christ. Seven centuries have elapsed since the previous crusade, and this last, or eighth, crusade differs from all its predecessors by having had its base in Egypt. The desert of Sinai, which separates Palestine from the Nile delta, has been heretofore passable only to caravans or relatively small bodies of men, owing to the difficulties of water supply and transport. But in this case it was conquered by engineering. A broad-gage railroad line was laid over the desert for a distance of some 250 kilometers, and an American pipe line is stated to have been installed to carry water from the Nile to the troops as they advanced. Scouting and reconnaissance were carried on by means of airplanes in radio communication with the advancing line. The eighth crusade succeeded not merely by valor and military skill, but also by the aid of engineering, with electricity taking its share.

Emergency Plants for France

THE coal crisis is world-wide and has already involved the mechanism of production to a serious extent. More than that, the labor required in mining and transportation is so very grave a matter in regions where man power is already short that the suggestions of Messrs. Clogher and Hammel in our current issue must be taken very seriously not only as regards France but in our own country as well. The situation in France is the more acute, but even here the quick development of considerable amounts of electric power is a step which should be taken at the earliest possible moment to help out in the present crisis.

France is in a specially bad way because coal has to be imported in large quantities under great difficulties, and its distribution puts added strain on transportation facilities already overtaxed in the conduct of the war. France has, however, a very large amount of water power, not generally in large blocks, but scattered rather widely over the central and eastern parts of the country, where it is within striking distance not only of industrial centers but even of the fighting front by modern methods of power transmission. There are a few great French projects like that for supplying Paris from the falls of the Rhone, but they are less quickly and easily developed than some of the minor ones. We need, too, in France liberal supplies of power for the necessary work back of our lines.

The suggestion of Messrs. Clogher and Hammel is an eminently workmanlike and sensible one. Experience in this country has taught that outdoor power stations and switching stations constitute now good conservative practice, and this is doubly true in the climate of France. Talk with a French or Swiss engineer of our extraordinary precautions against sleet, and he will stare at you open-eyed, wondering at the misfortunes which assail his American colleagues. Moreover, it is an indisputable fact that structures of elaborate and dignified architectural character are not in the

slightest degree necessary to house waterwheels and dynamo. They may prove impressive to the bondholder, but do not add to the effectiveness of the system. The proposition before us, therefore, is for the construction of hydroelectric units of as nearly standard type as practicable and their rapid installation, wherever feasible, to back up the industrial needs of the fighting fronts. There is nothing in the least impracticable about the idea.

The French government is probably in possession at the present moment of rather full details regarding a very considerable proportion of the water powers in France, including some of those whose development has already been studied. The efficient utilization of these would depend on the selection of such as make the least demands in the matter of time of constructing the hydraulic works, beginning operations at once, and concurrently starting production of hydroelectric units, transformers and line wires in this country. Much of the minor line material could undoubtedly be purchased in France, Switzerland or Italy more easily than it could be shipped from here. As is pointed out in the article, the delivery of the material does not make any great demand on tonnage and saves a large amount of continuous coal supply. Further, after the war is over, all these plants will prove serviceable in rebuilding the shattered industries of France, for which power will be sorely needed.

As regards the present power-plant requirement of the American army in France, we could well be undertaking it now by prompt co-operation of our own government with the French, and there are enough American engineers already on the ground to lay out and superintend the execution of the work. The distances to be covered are nothing serious from the American standpoint, and much of the construction would prove to be of permanent value. An obvious corollary of this proposition is that such plants should be thrust into service wherever possible in our own country. In this particular the lessons of the coal shortage may prove to be valuable ones. It is not often appreciated how much fuel hydroelectric plants save.

Power Requirements for Traveling Cranes

STILL another of Professor Clewell's excellent papers examines in considerable detail the special requirements of motor equipment for the traveling cranes in which it is so widely used. The electric crane needs no commendation here. It has become practically standard for all permanent work and for much temporary work. As its use has become more familiar the motor drive has been more and more refined. The things most imperative in its organization are unusual mechanical strength, accurate speed control and reliability. These have led to the development of many highly specialized devices, which Professor Clewell considers, and have resulted in apparatus which has proved exceedingly successful from every standpoint. One particular point in design to which attention should be directed is the question of efficient co-ordination between the speed and the requirements of the particular work for which the crane is designed. Here more than anywhere else is the finesse of the engineer needed in planning a successful crane equipment.

The New Bill Dealing with Water Power

APROPOS of the dire need of increase in the development of electric power to meet our fuel difficulties, attention should be called to the administration bill concerned with this matter which will soon come before Congress. Its provisions are in no respect worse and in some respects better than those of several previous bills which have failed of passage. The present scheme provides for the institution of a federal power commission composed of the Secretaries of War, the Interior and Agriculture. To them will be given rather plenary authority over the public lands and navigable streams. The development of the bill follows somewhat the lines of those of the preceding Ferris and Shields bills. It differs from them somewhat in the disposition of the receipts obtained from power licenses, in that all these go to the Treasury of the United States, with provision for the proceeds being used in specified portions for the service of the national forests, public lands and navigable streams.

As respects the service and charges of the licensee companies, they are to be regulated in all interstate relations, and in states having no public commission charged with similar work directly by the federal water power commission. The states having commissions, of course, retain jurisdiction over the service and charges wholly within their own territory. The most important part of the bill, as of others, lies in the matter of charges and the regulations concerning the tenure of the privilege. Under the present proposal the license charges must be not less than 10 cents per horsepower per annum without any maximum fixed and for a period not exceeding fifty years. At the end of the license period the United States may take over the entire development upon a suitable payment therefor, or it may issue a new license either to the old or a new licensee on such terms as may then seem equitable. Now it is just at this point that the success of the bill may be made or broken. The expenditures put upon such a property in a license term of fifty years involve the building up of a business and interconnections probably of a very intricate kind, with other plants and powers both on the public domain and on private lands. It is not clear from the present proposals on what basis the government will be at liberty to take over part or the whole of the resulting business. The present provisions would include payment for severance damage, which seems to be a more reasonable provision than has heretofore appeared.

After all, the success of this or any other water-power bill in developing water powers must in the last resort depend on the temper and policy of the government regarding private property at the end of a long but somewhat indeterminate period. If the licenses hold for fifty years, there is reasonable opportunity for making financial provisions which will take care of this element of doubt. If a policy of relatively short-term licenses should be inaugurated, the financial side of the matter would be left hung up in the air. It would be better to assure licenses for a minimum period long enough to allow the enterprise to be properly and profitably developed, and there seems no good reason why the fifty-year term should not be regularly specified, considering the large powers which lie with the com-

mission in the way of regulating service and charges. The uncertain factors in any short-term development must necessarily be reflected in the price paid for power. The present bill provides a complete defence for the consumer, and therefore there would seem to be no reasonable excuse for shortening the term of the license, and there might be good reason for lengthening it. The chief need is to pass speedily the best available regulations, under our existing limitations of knowledge of the future, to encourage speedy development of all the available powers. We need them sorely, and every bit of delay adds to the gravity of the situation. A liberal policy toward the investor will hasten the construction of much needed works; an illiberal one which leaves his future in grave uncertainty will simply serve to cause further delay.

Inherent Voltage Regulation of Direct-Current Units

A DIRECT-CURRENT generator unit may consist of the electric generator and its prime mover, say a steam turbine. Such a unit, when supplied with steam of definite pressure and quality at the throttle, will deliver current at a rated voltage. If the throttle is left open and the field rheostat of the generator is untouched, the delivered voltage will vary in a definite manner as the load is applied to the generator. If the machine is a shunt generator, the voltage may be expected to fall very appreciably as the load comes on. This is partly due to the fall in speed of the prime mover, and partly due to the *IR* drop in the generator armature, as well as to the reduced generator-field excitation.

In numerous cases where the unit is supplied by one and the same manufacturer the total inherent voltage drop under load can be estimated in advance from previously acquired data concerning the prime mover and the generator; so that the specifications for inherent voltage regulation in the unit seldom produce difficulty when the unit is tested before delivery. When, however, one manufacturer supplies the prime mover and another manufacturer supplies the generator, there is an obvious opportunity for disagreement between the two and the purchaser in case the inherent voltage regulation of the unit does not come up to the limits stated in the specifications.

In the case of a compound-wound generator the difficulties involved are much less, partly because the inherent voltage regulation is much better than in a shunt machine and partly because the field excitation at constant speed may be almost independent of the load, so that the correction for change in driving speed may be much smaller and easier to determine.

This question of resolving the inherent regulation of a unit into the proper proportion assignable respectively to the prime mover and to the generator is discussed this week in an article by W. B. Kouwenhoven. A simple technique and procedure are outlined for the case of a compound-wound generator. These call for the experimental determination of two characteristics of the unit—namely, voltage-load characteristic at constant steam pressure and the voltage-speed characteristic at no load and with adjusted steam pressure. From these two series of observations the voltage-load characteristic of the compound-wound generator for constant speed can ordinarily be inferred within satisfactory limits of precision.

The corresponding problem in relation to a shunt generator is much more complicated, as the article points out. In practice there is first the influence of change in speed on the delivered voltage at no load for constant field excitation. Second, there is the effect of change in temperature on the shunt-field circuit influencing the terminal voltage. Third, there is the effect of *IR* drop in the generator armature on the terminal voltage. Fourthly, there are the effect of change of voltage on the shunt-field excitation and its influence on the generated emf. The article offers no solution for this more difficult case. A solution has, however, been claimed by some engineers, although it is complicated and open to some uncertainty.

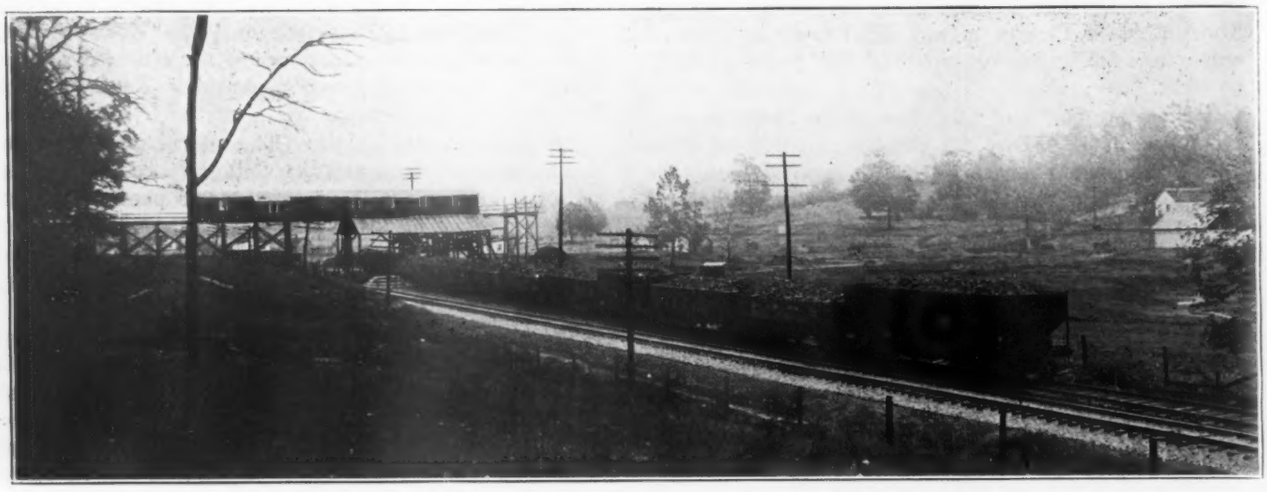
The Power Factor of Three-Phase Systems

THE power factor, or ratio of the active to the apparent power, in any single-phase alternating-current circuit considered as carrying substantially only the fundamental frequency is readily obtained from the readings of a voltmeter, ammeter and wattmeter connected to the circuit, or it may be obtained directly from the dial of a power-factor-indicating instrument joined to the circuit. In the case of a three-phase system, however, it is rare to find a power-factor indicator installed for the system, but the system power factor can be readily computed from the voltages on two sides of the system, the current strengths in two lines, and the readings of two wattmeters, one on each side. The computation is almost as easy for an unbalanced three-phase system as for a strictly balanced three-phase system.

E. G. Barrington develops this week a method for evaluating the power factor of a three-phase system when a polyphase wattmeter is employed. The method is shown to be applicable either to three-wire or four-wire three-phase systems. The method is evidently readily applied in the case of a balanced three-phase system. When the system is unbalanced modifications are described for making the necessary corrections, but the procedure takes considerably more time and is not as simple in application.

The Coming Issues

IN NEXT week's issue of the ELECTRICAL WORLD further attention will be given to the coal situation, which is of increasing seriousness and calls for the best thought and most careful management ever demanded by any exigency in the industry. The next installment of Professor Clewell's article will contain a discussion of the motor and control requirements for blowers, fan and air-compressor service. A rather technical article dwelling on the effect of color, thickness and temperature on the electrical properties of vulcanized fiber will also be presented on Jan. 26. Interest attaches to the results which will be given next week of somewhat unusual tests on electric range efficiencies.



Facing the Fact of Coal Shortage

Conditions of Supply Remain Very Serious for Central-Station Companies—How They Have Worked to Get Coal Enough to Provide a Reserve Supply—Cost High, Quality Poor

COAL supply conditions became increasingly serious as 1917 drew to a close; and in the opening month of the new year they are not only no better, they call for all the ingenuity of private and government agencies in order that the service of electric central stations may not be disrupted.

Contrary to precedent and cherished tradition of the central-station industry, service has been interrupted in many communities. To the extent that this is attributable to war needs and the urgent priority to which they are entitled, the industry has no ground for complaint; to the extent to which coal shortage is due to lax production methods or faulty distribution the industry passes criticism, not for the sake of complaining, but so that the conditions may be remedied as well as possible.

For a year the ELECTRICAL WORLD has consistently warned its readers of the dangers of coal shortage. It has advised forehandedness in accumulation of reserve supplies, has urged the study and introduction of economical boiler-room practices, has counseled quick and willing co-operation with efforts of the Fuel Administration to conserve power and coal. The object of the present article is to show how the companies operating steam stations using coal as fuel view the situation at present, what specific steps they have taken to lessen the strain of conditions, how they think improvement can be assured. The information published is based on a country-wide inquiry.

THE PROBLEMS OF COST, QUALITY AND SUPPLY

In general the companies have tried to meet these by furthering boiler-room efficiency, by looking more carefully into contracts for purchase of coal, by the purchase of mines in some cases and, so far as cost is concerned, by increasing rates for energy to large power users. In notable exceptions rates have not been increased.

An illustration of an analysis of boiler-room conditions which proved successful follows:

It was apparent during the latter part of 1916 that the demand for coal would be unusual, and in an endeavor to increase the general over-all efficiency of our production plants it was ascertained from a study of the log sheets that the greatest gain in economy would be in the boiler room. Previous to October the evaporation of one of our large boiler plants was averaging about the equivalent of 7 lb. (3.1 kg.), which gave a boiler efficiency in the neighborhood of 50 per cent. With this information we decided to make a thorough study of the boiler-room conditions and to conduct the necessary tests in order to ascertain the causes contributing to this lower efficiency. This study involved the handling of fires, draft conditions, gases, etc. We equipped all of our boilers with steam-flow meters and found that some boilers were carrying an average load of only 68 per cent of rating. This condition we found was caused by draft loss, settings, soot accumulation, etc. Capacity tests were run, and the best performance showed that only about rating could be got out of the boilers in the way they were operating and when they were entirely free from soot. These studies were conducted at a considerable expense, but we were able to increase the over-all efficiency of our plant by approximately 50 per cent.

We are not satisfied by any means that we have reached the maximum of the plant, but are continuing our studies from day to day, and the results justify a continuation of the expense involved. Coal clauses have been added to all large contracts and enforced.

Many companies installed coal-handling apparatus in order to be able to store even a greater reserve supply than under ordinary conditions, although subsequent events showed the impossibility of accumulating the amount of fuel desired. One company operating a relatively small plant spent $5,000 on coal-handling apparatus.

One of the greatest difficulties, about which widespread complaint is made, lies in poor quality. Typical comments on this condition follow:

Owing to our inability to get our regular run of coal, we have to take all grades and kinds of coal; consequently our operating conditions are not at all satisfactory. Our economy has been poor, and it is impossible to adjust our fire-room conditions for a very fine slack coal and then in the next half-hour have lump coal.

The quality of coal which we ordinarily obtain averages

about 13,500 B.t.u., with about 9 per cent ash. Owing to the difficulty of obtaining an adequate amount of coal, we have been compelled to burn all kinds down to that running as low as 9600 B.t.u. and as high in ash as 34 per cent.

Where coal has been purchased on the market we have not found it possible to control the quality, which is wretched.

In anticipation of serious coal shortage many companies planned to store extraordinarily large reserve supplies, while others, as stated in previous issues of the ELECTRICAL WORLD, bought coal mines or an interest therein so as to strengthen their control at the source. Most of the companies found it impossible to store coal in adequate quantities. One company, for instance, reports having "only about 15 per cent of that stock ahead of us which would insure against a shutdown resulting from a long period of inclement weather with the consequent delay in freight movement."

Another company, in which complete shutdown had just been threatened, writes that the Fuel Administration has thought it wise, in effect, "to clear out our stock piles and put us on a hand-to-mouth basis, thereby wiping out our own plans and provisions for the winter."

ENFORCED ABANDONMENT OF THE HISTORIC PRACTICE

Publication of this survey of the coal situation coincides with the most acute crisis, due to coal shortage, in electric central-station history.

The practice of storing adequate reserve supplies of coal to guard against the danger of mine or railroad strike or interruption of operation from any other cause has grown with the years. Its wisdom, tested time and again, has given the public continued service in past years. A less forehanded policy would have been followed by curtailed service or complete cessation of operation, with the result of public inconvenience and distress.

It is greatly to be regretted that events have prevented the companies from carrying out their time-honored, justified policy of maintaining adequate storage piles at generating stations.

When normal times are here again this policy will be re-established more firmly than ever. It is a necessary and effective safeguard.

The purchase of an interest in a coal mine gave one company sufficient coal to take care of requirements, although car shortage brought anxiety several times. However, there has been a considerable advance in the cost of coal to this company.

"Considering the expense other companies are having on account of the high price of coal," says this company, "we are of the opinion that the purchase of our interest in the mine has materially assisted us in this trouble."

A holding company which followed the policy of buying coal mines where the consumption of coal by the operating utility warranted it says: "We have been able to mine this coal at a considerably lower figure than the price fixed by the administration."

Experiences on the question of price vary widely because of the radical differences in coal-producing conditions and costs in the country. Increased cost, however, is the burden of the complaint. Comment on this point follows:

We formerly paid 85 cents per ton for coal at the mines, but we are now paying the government price of $2.85, plus 15 per cent for brokerage, with a possibility of paying 45 cents in addition if the miners get the increase for which they are asking.

I had occasion to collect some information with reference to effect on operating conditions, and my recollection is that before the present prices were established by the government the average increase in coal cost of the various companies with which I corresponded was about 145 per cent and the average increase in the operating cost was about 45 per cent.

Are buying coal at the market price, which is about 300 per cent more than it was two years ago.

We were fortunate enough to have made a contract for two years' supply of coal and have received the bulk of our coal under this contract, although we were forced to cancel it so far as price was concerned and pay practically the government price.

RAISING RATES TO MEET INCREASED COST OF FUEL

Many companies have raised rates to offset in part the increased cost of fuel, or plan to take this step. Some have not raised rates and do not expect to do so. One executive writes:

"We feel it a part of our patriotic duty not to raise our rates unless absolutely necessary. The new wholesale contracts that we have made carry a coal clause. These clauses, however, barely pay for the increased cost of coal, without considering other items."

The attitude of companies generally in trying to protect themselves by increasing rates is shown by the following statements:

The problems raised by increased cost of coal during 1917 came upon us so quickly that it was impossible to provide adequate additional revenue against them in time to have much effect upon the earnings for 1917. We have done something in the way of securing increased wholesale power rates, but not on all of our properties and have been able to do very little except get started in other directions.

We are endeavoring to meet, although it has not yet been accomplished, the increased costs of coal due to bonus which we have been obliged to pay in order to get the necessary supply, although under contract until 1921, by increasing rates. If we can obtain sufficient increases to offset the increased costs, we are perfectly satisfied. At this writing this has not been accomplished, and probably will not be accomplished for another sixty days.

Surcharges on power and steam-heating rates will yield approximately 45 per cent of our increased coal cost.

[A continuation of this article, to be published next week, will deal with other vital phases of the critical coal situation.]

Japan's Electrical Industries

The Department of Communications of Japan has published the following statement of the condition of the electrical industry in that country at the end of July, 1917: Plants supplying energy, 568 companies with $160,796,063 capital; electric railways, forty-two companies, $21,706,985 capital; engaged in both branches, forty-eight companies, $148,482,339 capital. Compared with the figures for the corresponding period last year there is an increase in the number of enterprises of thirty-five, with an aggregate capital of $17,892,057.

A Solution for an Acceptance-Test Problem

Simple Method of Correcting Generator-Unit Load-Characteristic Curve for Variations in Speed—Of Entire Accuracy When the Magnetic Circuit Is Highly Saturated

BY W. B. KOUWENHOVEN

Associate in Electrical Engineering, Johns Hopkins University

SYNOPSIS.—From experimental results the conclusion is drawn that there is no simple method for correcting the generator-unit characteristics of shunt generators for variations in speed unless the iron is highly saturated. In the case of compound generators the results show that there is a simple method for correcting the generator-unit characteristic for variations in speed. This method gives the true load characteristic of the generator within a plus and minus variation of about 1 per cent for ordinary machines. This method may also be used to determine a generator-unit load characteristic from the true generator characteristic of a given generator when that generator is combined with a prime mover whose speed variation with load is known.

AS THE load on a prime mover increases its speed falls so that the resulting regulation of a generator connected thereto is not the true generator regulation but a combination of the speed regulation of the prime mover and the voltage regulation of the generator. A question therefore arises sometimes when the generator and prime mover are purchased from different concerns whether the generator gives the regulation called for in the specifications* or some other value.

Such a case having been brought to the writer's attention, he undertook the problem of determining from the load characteristics of the generator unit the true load characteristics of the generator. The load characteristics of shunt and compound generators were studied both theoretically and experimentally. The experimental work was performed in the laboratories of the electrical department of Johns Hopkins University.

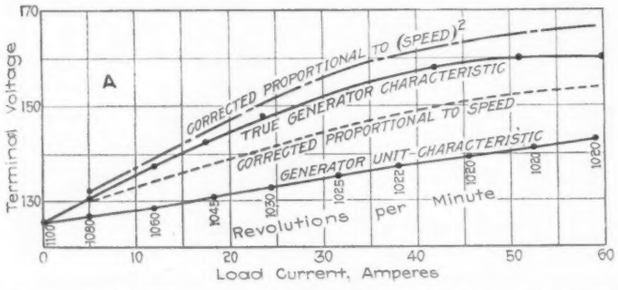


FIG. 1—CHARACTERISTICS OF GENERATOR CORRECTED FOR SPEED VARIATIONS

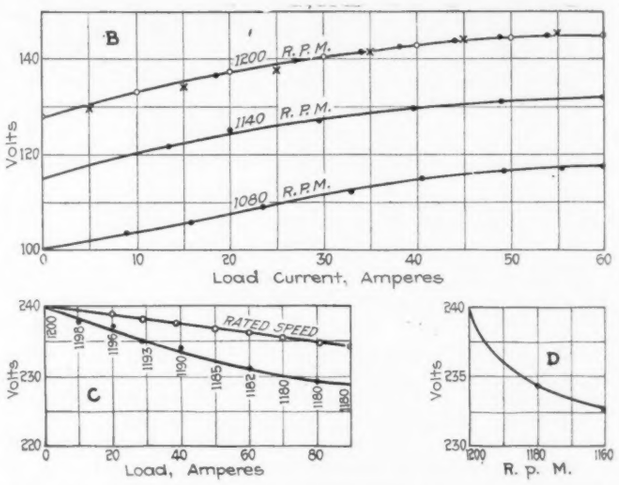
The lower curve is the load characteristic belonging to a generator unit. The figures 1100, 1080, etc., refer to the speed of the set at which the readings were taken. The upper full-line curve is the true generator-load characteristic taken at a constant speed of 1100 r.p.m. The broken-line curve shows the characteristic that is obtained when the generator-unit characteristic is corrected according to the ratio $(n_1/n_2)^2$ and the dotted-line curve is the characteristic that is obtained when the generator-unit characteristic is corrected proportional to the ratio n_1/n_2. It is evident that the true characteristic of the generator lies between these two corrected curves, and that neither of the above speed corrections gives a method by which the true characteristic or regulation can be determined from the generator unit characteristic or regulation.

THEORETICAL ANALYSIS OF REGULATION

At rated speed and no load the emf. induced in a direct-current generator is given by the relation

$$E = k_1 n \Phi,$$

where E is the induced electromotive force, n the revolutions per minute, Φ the flux per pole and k_1 a constant whose value depends upon the number of armature conductors connected in series, the number of poles and numerical constants.



FIGS. 2 AND 3—LOAD CHARACTERISTICS OF TWO COMPOUND GENERATORS, THE LATTER CORRECTED FOR SPEED

Since the flux per pole is proportional to the mmf. divided by the reluctance, and the mmf. depends upon the number of ampere turns that there are in the field circuit, $\Phi = k_2(i_f/R)$, where i_f is the field current in amperes, R the reluctance and k_2 a constant. Substituting the value of Φ in the equation for the induced voltage, $E = Cn(i_f/R)$, where C is a new constant which equals the product of k_1 and k_2.

The field current i_f is found by dividing the terminal voltage by the resistance of the shunt-field circuit. But at no load the terminal and induced voltages are practically equal and therefore the field current is directly proportional to the induced voltage E. Assuming there is no load on the generator and that at n_1 revolutions per minute the induced voltage is E_1, then at a lower speed of n_2 revolutions the induced voltage E_2 would be less by the ratio n_1/n_2, provided the field current was maintained constant. But in an actual machine, where the resistance of the shunt-field circuit is constant, the drop to E_2 volts would cause a proportional drop in the field current i_f. If the flux were directly proportional to i_f, the value of E_2 would be expected to be less than E_1 by the ratio of $(n_1/n_2)^2$.

However, the flux is not proportional to the field current because the reluctance of the iron is not constant. The reluctance decreases as the flux decreases, and the flux does not decrease as rapidly as the field current decreases. Therefore, the resultant change in induced voltage for a fall of speed to n_2 revolutions will

*A. I. E. E. Standardization Rules, Article 571.

be less than that given by the ratio $(n_1/n_2)^2$ and greater than that given by the ratio n_1/n_2 (see Fig. 1).

No simple method was found for correcting shunt generator characteristics for variations in speed unless the flux saturation of the iron was high (see Fig. 2). At high values of the saturation it was found possible to correct† the generator-unit characteristic-load characteristic by adding to it an ordinate that was equal to the drop in voltage between the no-load voltage at rated speed and the no-load voltage at the lower speed for which the correction was desired.

In securing the data for Fig. 2 the shunt excitation only was used, and load curves were taken for 200, 141 and 100-volt values of no-load voltage. The resulting characteristics are the curves *A*, *B* and *C*. The speed was maintained constant at rated speed throughout each run. Then, in order to investigate the effect of a change in speed, another set of curves was taken. In this second set the voltage was adjusted to the corresponding no-load voltage at rated speed, *i. e.*, 200 volts; the speed was allowed to drop 10 per cent to 1080 r.p.m., and a new characteristic was found during which the speed was held constant at 1080 r.p.m. The corresponding characteristics are given by the *A′*, *B′* and *C′* curves respectively.

Compound-generator characteristics were also studied graphically, using Arnold's methods. The analysis indicated that the method of adding to the generator-unit characteristic an ordinate which is equal to the difference in voltage between the no-load voltage at rated speed and the no-load voltage at the lower speed for which the correction is to be made will give good results and is furthermore simple in application. In order to test the correctness of this theoretical conclusion a number of compound generators were tested. As in the case of the shunt generator, load characteristics were taken at different speeds, the resistance of the field circuit remaining unchanged throughout. These points determined by the graphical method were found to lie almost entirely upon the true characteristic curves of the generators, their maximum plus and minus deviation being less than 1 per cent.

The success obtained with this method of correcting for speed variations led to a further study of other compound generators. In all of these tests the true load characteristic of the generator was obtained at constant rated speed. Then a load characteristic of the generator unit was obtained. In each case the set started at rated speed and the terminal voltage was measured as the load was applied, the speed being allowed to fall in accordance with the inherent speed characteristics of the prime mover. The load was removed and then at no load and rated voltage, or at the voltage for which the true-load characteristic was determined, a third curve, which will be called the no-load-voltage-speed characteristic, was taken by simply allowing the speed of the prime mover to drop and noting the armature voltage for various values of speed. The resistance of the field circuit was maintained constant throughout the entire run. The load characteristic of the generator unit was then corrected for speed variations by adding to it a correction obtained from the no-load-voltage-speed characteristic for the given reading (Fig. 3).

†E. Arnold, in "Die Gleichstrom Maschine," Vol. 1, p. 606.

The calculated load characteristics checked very closely with the true generator load characteristics and indicated that the correction is independent of the saturation and speed at which the characteristics are desired over a considerable range.

Application of the Method

A method of actually securing the data necessary for determining the regulation is as follows: Starting at no load, rated voltage and rated speed, take the necessary data for plotting the load characteristic of the generator unit, noting the speed at which each reading is taken. Remove the load and, starting again at rated voltage and rated speed, throttle the prime mover and reduce the speed throughout the same range of speed as was found when determining the load characteristic, noting the no-load voltage at various values of the speed. Plot the generator-unit characteristic, marking at each point the corresponding speed and the no-load voltage-speed characteristic of the unit.

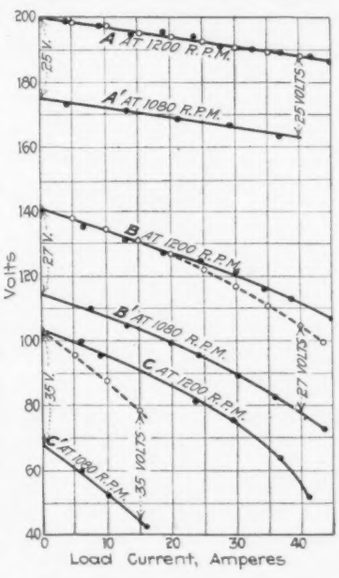


FIG. 4—MEASURED AND CORRECTED CHARACTERISTICS OF SHUNT GENERATOR, SHOWING AGREEMENT AT HIGH SATURATION

For a given point on the generator-unit characteristic determine the correction as follows: From the no-load voltage speed curve determine the difference in volts between the voltage at rated speed and the voltage at the speed corresponding to the given point. Add this difference to the ordinate of the generator-unit characteristic at the given point and the corrected point will lie on the true generator characteristic curve of the machine.

Proceed in a similar manner to correct the other points on the generator-unit characteristic. Draw the curve through the corrected points and the result will be the true generator load characteristic. From this curve the true regulation of the generator can be found.

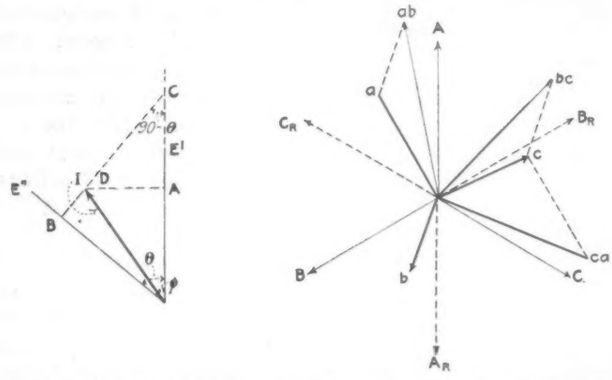
Not only can the true load characteristic of the generator be obtained from the generator-unit characteristic by this method, but it may also be applied in the reverse direction and the generator-unit characteristic determined from the true load characteristic of the generator. If the load characteristic at constant speed and the voltage-speed characteristic of a given generator are known, it is possible to predetermine, by the use of this method, the load characteristic that will be obtained when the generator is combined with a prime mover whose speed variation with load is known. In such a case the proper ordinate for a given drop in speed below rated speed is determined from the voltage-speed characteristic curve, and this ordinate is subtracted from the true load characteristic of the generator. The resulting curve is the load characteristic curve of the prime mover and generator combined.

Obtaining Power Factor by Use of Wattmeter

Explanation of the Manner in Which, by Making Simple Change in Connections of Polyphase Wattmeter, Power Factor on Three-Phase Circuits May Be Readily Obtained

BY E. G. BARRINGTON
Toronto Hydroelectric Commission

ALTHOUGH several methods have been proposed for obtaining the power factor on three-phase circuits, most of them prove to be incorrect when the phases are unbalanced, which is usually the case to a greater or less extent on all commercial circuits. By means of the following method the power factor of any



FIGS. 1 AND 2—VECTORIAL RELATIONS EMPLOYED IN DEVELOPING METHOD OF OBTAINING POWER FACTOR BY WATTMETER

three-phase circuit, three-wire or four-wire, on which the voltages are balanced may be obtained from the indications of a polyphase wattmeter when a simple change is made in the connections of the potential coils. It may also be used when the voltages are unbalanced, but in this case it is necessary to take additional readings, as will be explained later.

Demonstration of Theory

The principle upon which this method is based may be demonstrated as follows: Let I and E' (Fig. 1) represent the voltage and current of an alternating-current circuit in which I lags behind E' by the angle φ. The reactive component of I may be obtained if the component of I in phase with E' and also another voltage of known phase difference from E' is known. Let E'' represent a voltage θ degrees behind E'. Then OA and OB are the components of I in phase with E' and E'' respectively, and AD is the reactive component. Draw BC perpendicular to E'' to meet E' at C.

Then $OC = OB/\cos\theta$.
$OB/\cos\theta - OA = AC$.
But $AC \tan (90 - \theta) = AD$.

Therefore $[(OB/\cos\theta) - OA] \tan (90 - \theta)$ = reactive component of I.

$$\text{And } \tan\varphi = \frac{[(OB/\cos\theta) - OA] \tan (90 - \theta)}{OA}.$$

The components OA and OB may be obtained from the readings of a wattmeter to which the current I is connected and the voltages E' and E'' are applied in turn. Calling the first reading R' and the second R'', OA is equal to R'/E' and OB equal to R''/E''. If, however, E' and E'' are equal, R' and R'' are proportional to these values and may be substituted for OA and OB in the above formula.

Referring to Fig. 2, in which the voltages of a three-phase system are represented by A, B and C and the currents by a, b and c, the current in the three lines will be ab, bc and ca. The currents ab and bc are considered as flowing through elements R and L of a polyphase wattmeter, in which case voltage A will be connected to element R and voltage C to element L.

By reversing voltages C and B (in which case they will be represented by C_r and B_r) and connecting them, instead of voltages A and C, to elements R and L respectively, a reading proportional to the components of currents ab and bc in phase with voltages lagging 60 deg. behind voltages A and C will be obtained. From this reading it is possible to find the total reactive voltamperes and the tangent of the angle of phase difference by means of the preceding formula. This reading will be positive for any value of this angle between 30 deg. lead and 90 deg. lag.

For values between 30 deg. lead and 90 deg. lead it will be necessary to use the voltages B_r and A_r in order that the angle between the voltages may remain 60 deg. and so the same formula may apply. These voltages may also be used for any angle between 30 deg. lead and 30 deg. lag, making the total range with the lagging voltages from 30 deg. lead to 90 deg. lag, and with the leading voltages 30 deg. lag to 90 deg. lead. In the majority of cases at least the power factor of a given circuit does not vary over these limits. However, if this is not the case, an additional double-throw switch will enable either set of voltages to be connected to the meter.

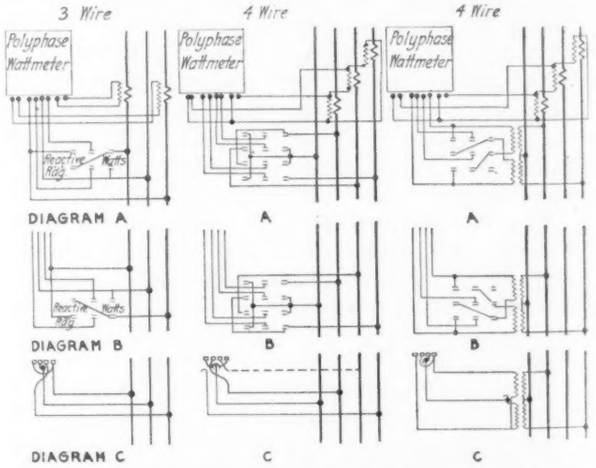


FIG. 3—CONNECTIONS NECESSARY FOR MAKING READINGS

By means of this change in connections the two values required for the formula are obtained, the angle θ being

60 deg. The formula may now be written in a much simpler form, thus:

$$\frac{[(R''/\cos 60) - R'] \tan 30}{R'} = \frac{2R'' - R'}{\sqrt{3}R'}.$$

CONNECTIONS NECESSARY FOR MAKING READINGS

The connections which will give the required voltages under different conditions are as shown in the accompanying diagrams (Fig. 3), which give the connections for both leading and lagging voltages. It is impossible to tell which will result in leading voltages and which in lagging voltages, as this depends on the direction of phase rotation, which is not generally known. The correct one may easily be found, however, by trying out each connection and using the one that gives a positive reading, or the highest positive reading if both are positive, which will be the case if the power factor is above 87.7 per cent.

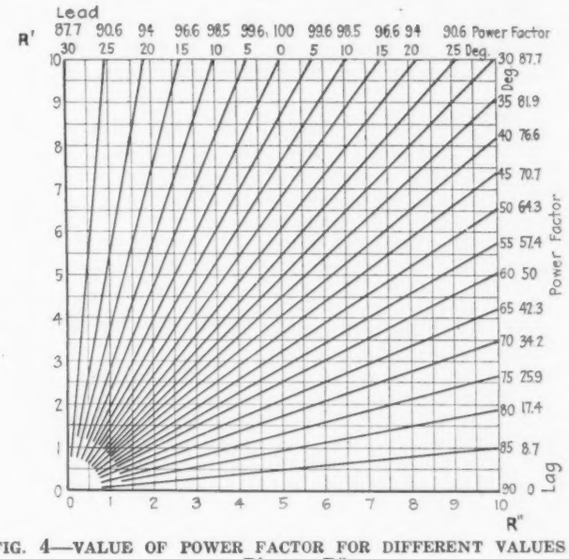


FIG. 4—VALUE OF POWER FACTOR FOR DIFFERENT VALUES OF R' AND R''

As a check on the connections it may be noted that a decrease in the power factor will cause a decreased reading on the meter with a given load in watts. Also, that at 100 per cent power factor the reactive meter will read 50 per cent of the reading of the wattmeter. At other power factors the ratio will be as follows:

Power Factor, per Cent	Ratio Watts to Reactive Reading
87.7	1:1
50	1:2

In case both connections give a positive reading, one reading will, when applied to the formula, result in a negative angle, thus indicating that leading voltages are being used with a lagging current or vice versa. By means of the accompanying chart (Fig. 4) the power factor may be read without the use of the formula. The scales R' and R'' in the chart may, of course, be changed to correspond with the scale of the meter. In case the chart is used with a leading power factor it is necessary to interchange the two words "lead" and "lag."

A useful and easily remembered method of temporarily changing the connections of a three-wire meter is shown in diagram *C* of Fig. 3. This change is most easily made at the meter terminals as follows: Disconnect the line wire on one element and the common wire on the other element; connect the disconnected line wire of the one element to free terminal of the other; connect the two line terminals together, the position of the voltages obtained with reference to the original voltages depending upon which element the line wire is disconnected from. The connection for four-wire meters cannot usually be so readily changed, since for meters operating at line voltage it is necessary to carry an additional wire from the meter to the line, while with transformer meters the two transformers are usually connected to a common line. In this case it is necessary to open this connection. The required changes are, however, shown in the diagrams.

MODIFICATIONS NECESSARY WHEN VOLTAGES ARE UNBALANCED

While the formula in its simpler form is strictly correct only when the voltages are balanced, the amount of unbalance usually found on commercial circuits is not enough to affect seriously the result. The errors introduced may, however, if necessary, be corrected; but inasmuch as the value and phase difference of the voltages on each element will not be equal under these conditions, it is necessary to treat each element separately as follows:

With the potential circuit of one element open and a voltmeter connected across the potential terminals of the other, take readings on the wattmeter and voltmeter with the meter connected for both watts and reactive reading; then change over to the other element and take readings as before. Call the wattmeter readings V' and V''. It will be found that two of the four voltmeter readings obtained will be equal since they have been taken on the same phase. By constructing a triangle with sides proportional to these values the angles between any two voltages may be measured. The value of the reactive volt-amperes for each element may then be found from the following formula:

$$\tan (90 - \theta) \left[\frac{R'' \times V'}{V'' \cos \theta} - R'\right],$$

θ being the angle between the voltages V' and V''.

For four-wire meters operating at line voltage the formula is as follows:

$$0.577 \left[\frac{2R'' \times V'}{V''} - R'\right].$$

The algebraic sum of the reactive volt-amperes obtained for each element divided by the total watts will give the tangent of the angle of lead or lag.

Pacific Coast Company to Use Sawmill Waste for Fuel

Announcement has just been made in San Francisco that the Northwestern Electric Company of Portland, Ore., has contracted for construction of a 15,000-hp. steam generating station which will use sawmill refuse for fuel. This refuse consists of bark, splinters, short ends, slabs and sawdust, etc., which the lumber trade terms "hog fuel," and which has a very low value at the mill. It is understood that recent development of shipbuilding activity in Portland has created an increased power demand which is taxing the capacity of the system to the limit. The use of the new fuel will be a war measure in coal and oil conservation at the same time that it is expected to prove very economical.

Helping France to Help Herself

Hydroelectric Power Can Supplant Her Coal Supply Better than It Can Be Done by More Ships, and American Emergency Construction Can Provide Such Plants in from Six to Nine Months

BY ALEXANDER C. CLOGHER AND VICTOR F. HAMMEL

The object of the electric organization of the army is to distribute light and motive power as near as possible to the firing line by applying the established methods of the industry. Electric lighting of a general nature is the thing which next to nourishment contributes the most to maintain the morale of the men. Moreover, the use of electrical energy in the territory occupied by the armies increases the product of manual labor in multiple forms, a consideration not negligible in a war of attrition such as that we are waging.—Capt. Gustave P. Capart of the French Army, ELECTRICAL WORLD, Nov. 3, 1917.

EVERY man that we send to France, whether for the firing line or behind it, will necessitate the manufacture of additional electric power for ministering to his needs and comforts. The shops for repairing our rifles and guns will probably be larger than most of the munition plants in this country. These shops must be run by electric power. Most of the electricity generated in France is derived from coal. As France has no coal to spare, we must either make use of some of our ships for transporting our fuel for producing this power or obtain the power from other sources.

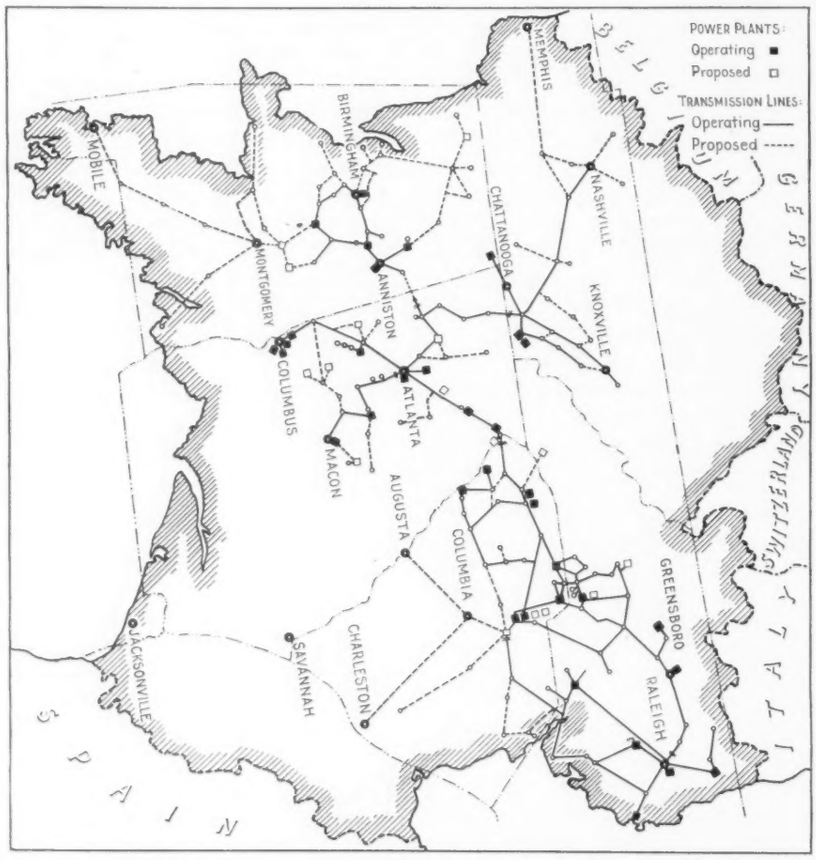


FIG. 1—INTERCONNECTED TRANSMISSION SYSTEMS OF THE SOUTH SUPERIMPOSED UPON THE MAP OF FRANCE

Electricity is produced from two sources, viz., fuel, either coal or oil, and water power. France has no oil, an inadequate supply of coal but a large amount of undeveloped water power, a latent force which should be utilized for supplying the mechanical power so necessary in the prosecution of modern warfare.

It is well known that there is a great scarcity of coal in France, but it is probably not generally realized that a large part of the coal which is available from the French mines must be used for the manufacture of electric power for the use of the army, navy, munition industries and, lastly, for the absolute necessities of commercial life. These demands on the scant fuel supply have raised the price of coal to a point where it is practically out of the question to use it for heating dwellings. This lack of heat has caused a great deal of suffering among the French people, and any measures which might be taken to relieve our ships from the duty of transporting fuel for our fighting forces could also be utilized to relieve the coal famine in that country.

The only practicable method remaining for relieving the coal shortage in France, other than providing more ships for the transportation of coal and oil, is to utilize some of the undeveloped water power now going to waste in that country. It is possible for the United States to render signal aid to France in the development of this power, because of the large amount of capital required.

Conservatism has prevented the most progressive development in the use of electricity in the countries of Europe, just as it has held it back in the northeastern part of the United States. In this country we have our most complete and economical electric systems for the generation, transmission and distribution of electric power in the West and the South. Here we find a number of public utility companies serving territories as large as Switzerland from an interconnected transmission system. These companies generate, most economically, practically all of the power used by their respective communities in a few modern steam plants or in a number of hydroelectric plants.

Although there are many excellent examples of modern hydroelectric developments in France and Switzerland, it is probable that American engineers could more clearly see the potentialities for the complete develop-

ment and use of all of the hydroelectric resources in those countries. American practice proves that it would be possible to develop all of the available water power on a range of mountains in France and to distribute it throughout several provinces, whereas present developments in that country generally consist of the power available on a stream distributed to a few nearby towns and villages.

THE PROBLEM OF SHIPS

It would be unfortunate if our government did not awaken to the possibilities of this idea, which to the authors seem to be as effective a method for relieving the shipping shortage as the construction of more ships. The same amount of money would be required to build two 5000-ton steel vessels as would be required to build a 10,000-hp. hydroelectric or steam-electric power plant in France. Two such ships could easily transport all of the material required for construction in either case. On completion, the steam plant would require the continuous service of both vessels for supplying it with coal, in addition to the men and transportation facilities required in this country for mining and delivering the coal to the seaboard. The hydroelectric plant, when completed, would require the services of fewer than half a dozen men. This is indeed true conservation of man power and of natural mineral resources. It could be done not only for 10,000 hp., but for 100,000 hp., and it would release, not two ships, but twenty or more large-sized freight-carrying vessels.

If there were undeveloped power sites near our army base, the simplest solution of the army power problem would be for it to lease or purchase these power sites, develop whatever hydroelectric power it might need for its own use, and in this way avoid the necessity of using ships for transporting coal for steam-power plants which might otherwise have to be built.

LONG TRANSMISSION LINES

The topography of France, however, does not lend itself to so simple a solution of the problem. Most of the available water-power sites are situated in the extreme eastern and southern parts of France, and those nearest to our army's operations are of the type which require the longest time for construction. At first glance the transmission of water power from the Alps and Pyrenees for our army base seems out of the question because of the distance. When one considers, however, that coal in France is worth $60 to $70 per ton, the transmission of hydroelectric power 400 miles or even 500 miles (650 km. to 800 km.) might not only be economical but it might be desirable in any event in our conduct of the war, if it would make more ships available for transporting other supplies.

The solution of the problem might be an indirect one,

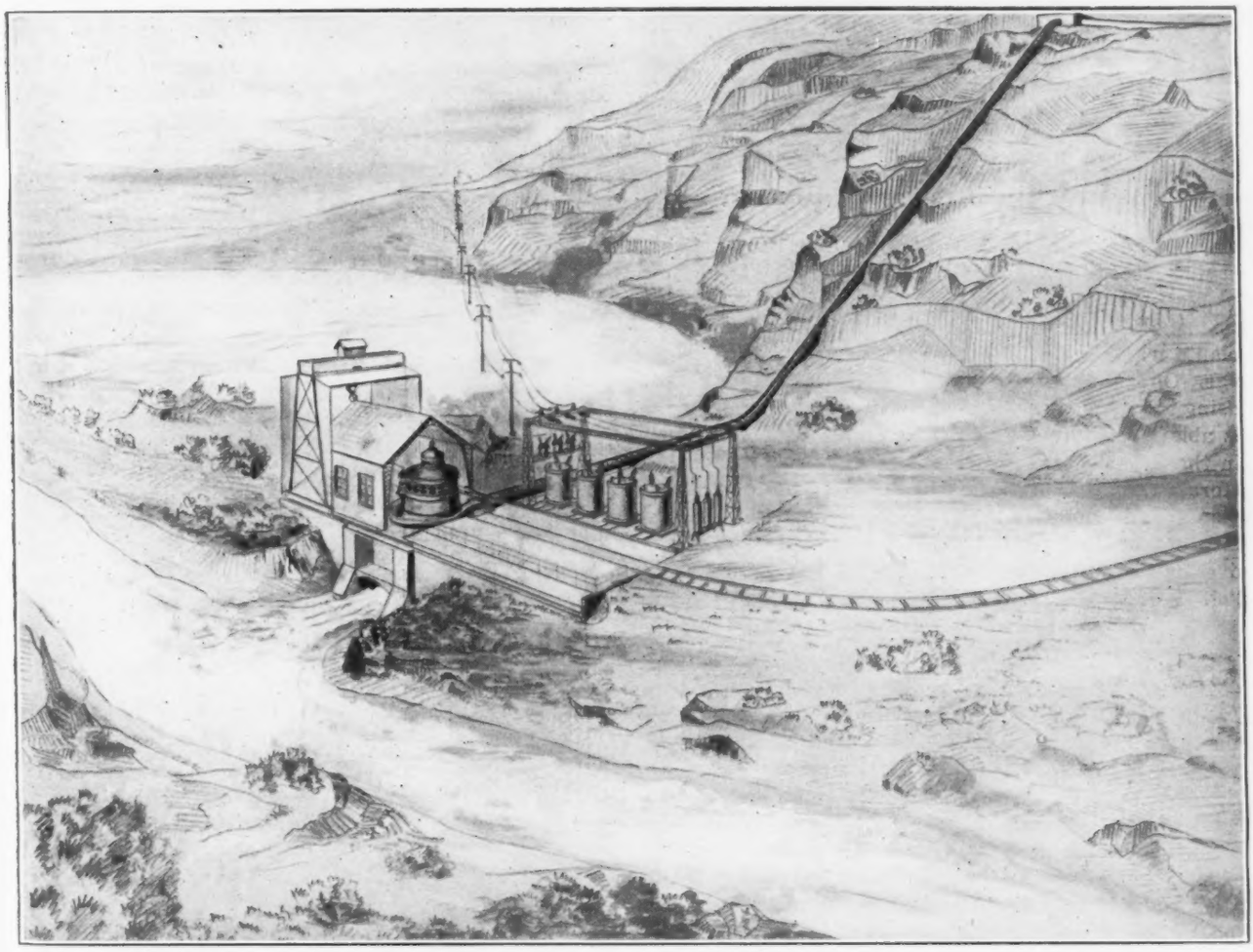


FIG. 2—PLANTS OF THIS TYPE OF FROM 1000 HP. TO 15,000 HP. CAPACITY WILL HELP SOLVE THE COAL PROBLEM IN FRANCE AND RELEASE COAL-CARRYING SHIPS FOR OTHER SERVICE

and our army might secure its coal by releasing the coal now used for producing commercial power in western France. We might provide hydroelectric developments for supplying this commercial power.

In localities where all of the available hydroelectric power is developed in small independent units there is certain to be an excessive waste of energy. It is impossible to make the demand for power from each

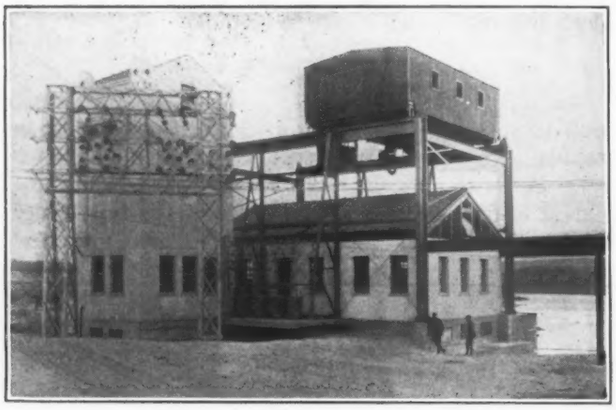


FIG. 3—A 10,500-HP. HYDROELECTRIC UNIT IS HOUSED HERE; THE ROOF ROLLS ASIDE SO THAT THE ELECTRIC CRANE OVERHEAD CAN LIFT THE HEAVY MACHINERY

small market conform to the supply of water available at its respective small power plant or plants. Some plants have large storage available which can be used to make the output uniform from a large number of plants which may have a great variation and no storage. One of our public utilities in the Rocky Mountains, using the power generated on about twenty-five streams, is able to provide a uniform production of power even in the dryest year, on account of the large amount of storage it has on one stream only. This company's plants and customers are scattered over a territory larger than Switzerland, and 70 per cent of its production is transmitted 140 miles (225 km.) to its market.

Government Aid Necessary

If it would be possible to secure from the French government rights which would insure the quick possession of the undeveloped water-power sites in France, efficient plants might be constructed and completed just as quickly as steam-power plants which the American Expeditionary Force would have to erect in order to carry on its operations.

Such development would require a tremendous outlay of money and could not be undertaken privately without a government subsidy. It might be accomplished by a federal corporation similar to our Emergency Ship Corporation. Such an undertaking would of necessity move slowly, and undoubtedly the greatest success (because the quickest) could be attained by making the project one of the auxiliary operations of our army.

Under the conditions it would appear that the most effective way to expedite victory over the enemy would be the emergency construction of water-power plants. It is not a question of conservation but the urgent need of the moment that should determine the action to be taken.

American practice is particularly well adapted to emergency construction. A great deal of our hydroelectric development has been done in the rough, mountainous and sparsely settled country west of the Mississippi Valley, where the power was desired quickly for mining purposes, or for some town or city far from the power site. Consequently, methods of expediency were used which have been impossible in older and more settled communities.

Examples of American Engineering Genius

The American engineer has often been told to secure results quickly and to expend the minimum amount of money. He often made mistakes, which many plants in existence to-day attest, but he has developed designs and types of construction which will admit of the quickest possible construction. To realize what has been accomplished one need only review our Western developments, with their successful outdoor equipment and elimination of large power houses. Comparatively, these are simplified structures, and incidentally enormous strides have been made in the time required for construction.

To illustrate the adaptation of such construction to emergency development, note the sketch of a 7500-hp. one-unit installation. This general idea could be used for a very wide range of water-power sites of from 1 hp. to 15,000 hp. in size. In this type of development the water is diverted by a small, low dam and conducted along the stream bank in a wooden pipe or flume, or in a concrete-lined canal. All the equipment is of simple character, which could be manufactured and assembled in America and set up in France, and be in operation in less than sixty days after its receipt at the site. The concrete work is of the simplest nature, and could be completed before the arrival of the machinery.

The gantry crane and the small steel building run on separate tracks, and both can be erected off to one side before the foundations are completed. It should be noted that with such a scheme no time is required to build a massive power house before the erection of the vital machinery can commence. The average American

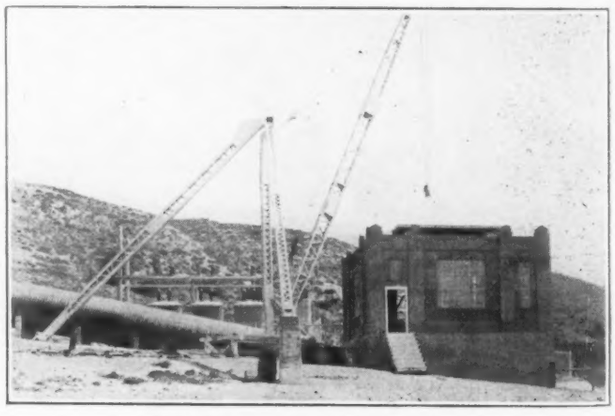


FIG. 4—AN ATTENDANTLESS 2000-HP. STATION AT WHICH NOTHING IS INSIDE THE BUILDING EXCEPT THE WATERWHEEL AND GENERATOR

layman, and even many engineers, when thinking of power stations have in mind the esthetic structures seen on the large rivers in the Eastern States and the expensive steam plants in our large cities, all of them large structures and imitating in various degrees the architecture of almost every conceivable type of monumental building, from prisons to libraries.

European engineers are more prone to build such

monuments. In their densely populated countries they have always been required to erect imposing structures with infinite devotion to detail, that the developments might harmonize with the surroundings. After the war the emergency plants could be reconstructed and imposing superstructures might be erected over them to cover them up. It is questionable, however, if this would ever be done once the custom of placing this type of machinery outdoors were established.

Such a station could be operated individually or by tying in by transmission lines with a number of similar plants. Ten of these small single-unit plants tied together with transmission lines would give more reliable service than one large station containing ten generating units. A development of this type would be made to deliver power surely within a period of six months from the day of inception and selection of the power site. Hydraulic-equipment manufacturers in America have wonderful facilities, which are not being utilized to the best advantage because of the lack of this kind of construction.

It is hoped that we shall not be dilatory in grasping this wonderful opportunity to help France. Had Switzerland started developing extensively her abundant water power at the beginning of the war she would not have been forced to tie herself, perhaps irrevocably, to German control. Recently she was forced into very unfavorable trade agreements in return for coal that she could not obtain elsewhere.

America has tarried too long over conservation policies at home. Cognizance of this has been taken by President Wilson, and has called forth this admirable warning to Congress in his address of Dec. 4: "It is imperatively necessary that the consideration of the full use of the water power of the country and also the consideration of the systematic and yet economical development of such of the natural resources of the country as are still under the control of the federal government should be resumed and affirmatively and constructively dealt with at the earliest possible moment. The pressing need of such legislation is daily becoming more obvious."

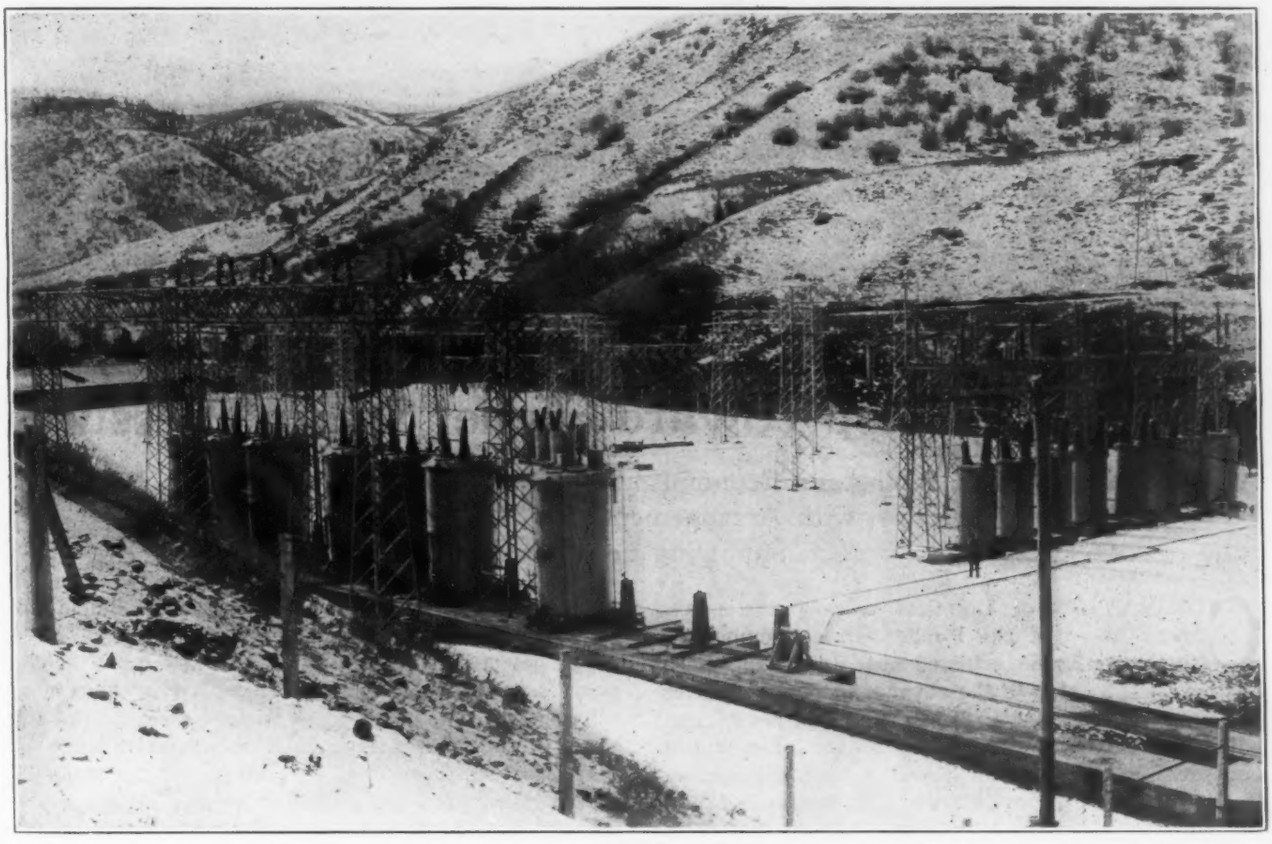
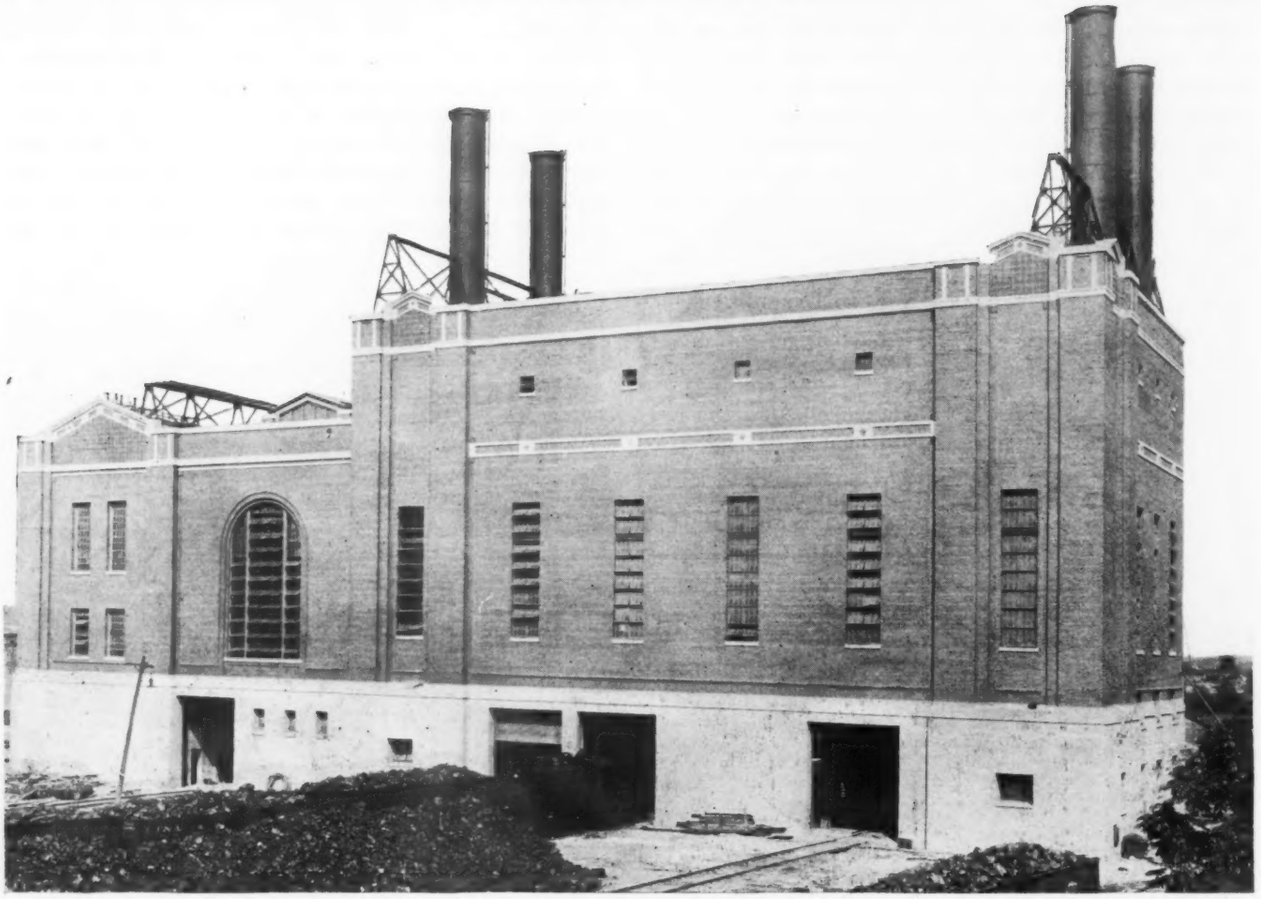


FIG. 5—NO BUILDINGS ARE REQUIRED FOR MODERN 130,000-VOLT ELECTRICAL EQUIPMENT

Making Reports for the Income Tax

Income-tax experts are to be sent to every county seat and other cities and towns to meet the people and explain the provisions of the new federal income-tax law. Returns must be made by March 1. The government recognizes that many persons will have a good deal of difficulty in filling out income-tax forms and that taxpayers resident at points where collectors' offices are not easily accessible find it hard to get proper instruction in the law.

Every married person living with wife or husband and having a net income of $2,000 or more, and every unmarried person not the head of a family and having a net income of $1,000 or more, for the year 1917, must make a return of income on the form prescribed by the law. Very many people assume that if an income-tax form is not sent or a government officer does not call, they are relieved from making a report. This is decidedly an error. The taxpayer has to go to the government, and if he doesn't go within the time prescribed he is a violator of the law and the government will go to him with its penalties.



Joliet Plant a Step Toward Higher Steam Pressures

Features of Boilers, Piping and Economizers in New Joliet Plant of Northern Illinois Company, with Arrangements for Handling Coal and Supplying Feed Water

COMPLETION of the first unit of the newest power house of the Public Service Company of Northern Illinois, situated near Joliet, Ill., marks another distinct step in the advance in power-plant engineering. A pressure of 325 lb. (22.8 kg. per sq. cm.) will be developed in the boilers at the Joliet station, and pressures around 300 lb. (21.1 kg.) will be used in the turbines. One 10,000-kw. (12,500-kva.), 12,000-volt machine is already in operation and another of the same size is being erected. This high-pressure practice, of course, makes possible a higher over-all plant efficiency by increasing the upper limits of the thermal cycle. Just what the exact extent of the gain in efficiency will be on account of adopting this practice will not be definitely known until the plant has been run under operating conditions.

The station was built on a carefully chosen site, on which it can be extended in unit sections to an ultimate rating of 60,000 kw. or more. While it is very far from the geographical center of the territory served, it is in reality very near to the electrical-load center of the present system. Moreover, the present tendency of industrial growth seems to indicate a more rapid development between Chicago and Joliet than south and west of the latter city. An adequate supply of good water and fuel is available, the former from the Desplaines River, which is constantly fed from Lake Michigan, while coal can be received from Illinois and Indiana over either of two trunk-line railroads.

The general arrangement of the apparatus in the plant is not radically different from that in other modern stations. The boiler room, turbine room and switch house are all on one level. The present installation of two 10,000-kw. horizontal generators and the probable future installation of two larger similar machines are laid out in a single line end to end. The three boilers are arranged in the usual fashion along both sides of a firing aisle. The electrical installation is practically that which is standard for supplying 12,000-volt energy for industries near the station and 33,000-volt energy for transmission.

Some of the Features of the Plant

Although the boilers are of the standard B. & W. cross-drum type, they are built to withstand higher than the usual pressures. The plates in the boiler drum are 1 5/16 in. (3.33 cm.) thick, the longitudinal seam being a butt and double-cover strap quadruple-riveted joint. The heads are secured by two rows of rivets. Tubes of No. 7 gage as compared to No. 10 for 200-lb. (14.1-kg.) pressure are used. All high-pressure steam piping is extra heavy and of relatively small diameter owing to the density of the steam. The length of straight runs has been limited, and numerous long-

radius bends are employed to provide for expansion. All fittings are of steel, the manifolds used in connection with the boiler leads having been cast and the smaller fittings forged. On pipes above 4 in. (10.2 cm.) diameter a special bolted joint with a welded seal at the periphery is used.

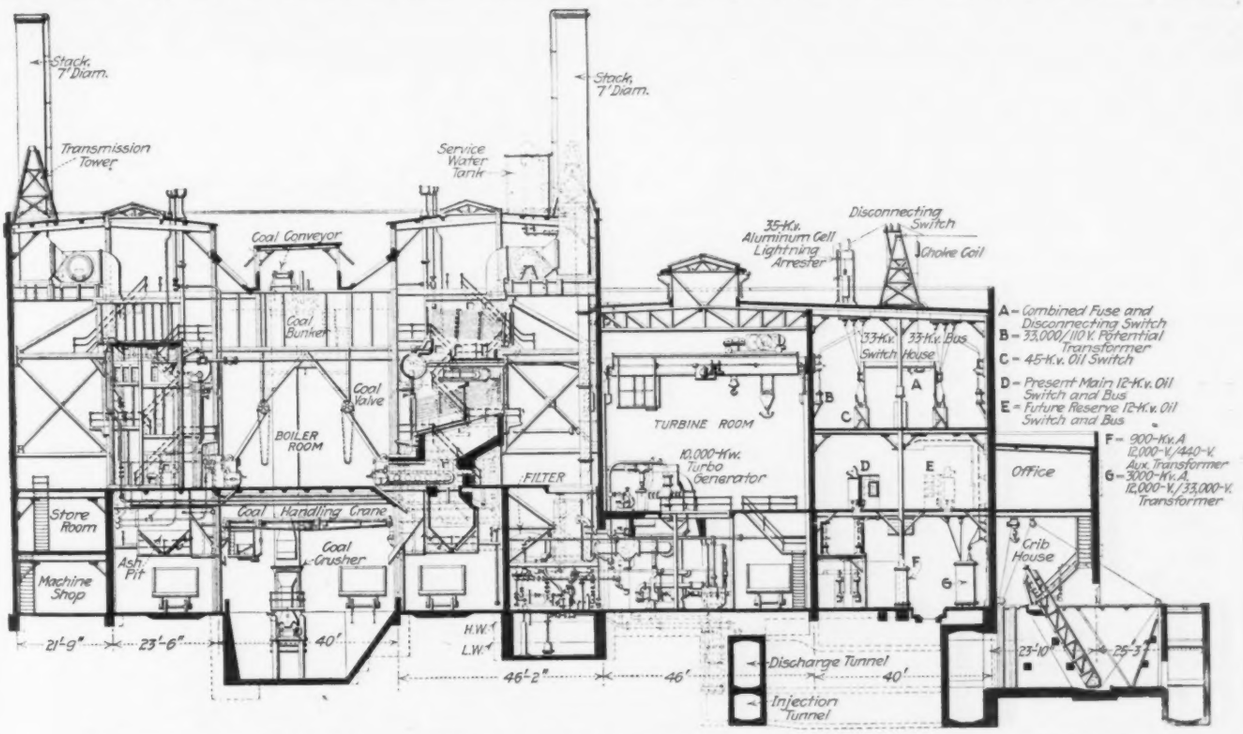
A notable feature of the steam equipment is the individual all-steel horizontal-tube economizers, the first of their kind in this country. Each economizer is placed above and integral with the boiler, with no dampers between, so that the gases pass directly from one to the other. The economizer is really a part or stage of the boiler. Furnace gases pass from the economizer at such low temperatures as to permit unlined steel stacks.

Another feature of the plant is a basement entirely above ground, the main operating floor being the second story of the building. This construction was employed as the plant is in an old stone quarry, which would have made excavation costly. Moreover, the construction gives head room for coal and ash cars to operate at the ground level and eliminates ash-handling equipment. There is gravity flow for the coal from the overhead coal bunker to the stokers and for the ashes from the stokers to the railway car waiting to receive ashes directly from the hoppers under the stokers.

Outside of stoker engines held as reserves for motor drives, there is no reciprocating machinery in the station. All pumps are of the motor-driven centrifugal type with the exception of the boiler feed and one service pump operated by turbines. Provision is made to bleed steam if desirable under thermostatic control from the fourth stage of the main turbine. Another innovation is to utilize the condenser for drawing boiler make-up from the fresh water reservoir. The water enters the condenser and is passed to the heater in the usual way by the condensate pump.

For each 10,000-kw. generating unit there will be two cross-drum water-tube boilers, each having 9919 sq. ft. (970.8 sq. m.) of steam-making surface, a built-in superheater with 3100 sq. ft. (288 sq. m.) and an economizer containing 6730 sq. ft. (625 sq. m.) of surface. There are now three boilers in the plant, but when the second generating unit is installed another boiler will be added. With a good grade of Illinois coal it is the intention to use three boilers to carry the two generating units, leaving one boiler in reserve. Under this arrangement there will be 1.49 sq. ft. (0.1386 sq. m.) of active steam-making surface per kilowatt of generating capacity, or on the basis of 10 sq. ft. (0.92 sq. m.) 1 boiler-hp. will serve 7.67 kw. This does not take into account the economizer, which is really the first stage of the boiler. Each boiler, with its steel casing, masonry setting and retreating back, covers at the floor line an area of 294 sq. ft. (27.3 sq. m.), or 0.296 sq. ft. (0.022 sq. m.) per horsepower (10 sq. ft.) of rating. Including the overhang and the space occupied by the stokers, the floor space covered is 585 sq. ft. (54.3 sq. m.), or 0.59 sq. ft. (0.055 sq. m.) per horsepower. From the boiler-room floor to the top of the economizer the height is 42 ft. (12.8 m.).

Two chain grates are placed side by side in a common furnace, each being 8 ft. (2.4 m.) wide, 14.5 ft. (4.4 m.) long and containing 116 sq. ft. (35.15 m.) of active grate area. The ratio of the total grate area to the steam-making surface is one to forty-three. The stokers are motor-driven through reduction gears and belts, with vertical engines in reserve. The general design of the setting and the positions of the economizer and induced-draft motor-driven fan are shown in the plan. Rising 65 ft. (19.8 m.) above the fan or 125 ft. (38.1 m.) above the grate is an individual self-supporting steel stack 7 ft. (2.13 m.) in diameter. Owing to the low temperature of the flue gases leaving the economizer (350 deg. Fahr.) the stack is unlined. The inner surface is lined with a heavy asphaltic paint.



RELATIVE POSITIONS OF PLANT APPARATUS AND ARRANGEMENTS FOR DISPOSING OF ASHES AT GROUND LEVEL

Being the first of its kind in this country, the economizer is of special interest. The construction is similar to that of a B. & W. boiler, except that no drums are used. The headers are of wrought steel and the tubes are 4 in. (10.2 cm.) in diameter, ¼ in. (0.63 cm.) thick and 16 ft. (4.8 m.) long, of drawn steel. As low temperatures are expected, the tubes are galvanized inside and out to guard against corrosion. The economizer is vertically baffled for three passes, the gases from the boiler entering at the front and from the third pass rising vertically through the induced-draft fan to the stack. The fan has capacity to handle 75,000 cu. ft. (2100 cu. m.) per minute of gas at 350 deg. Fahr. At this rating the power required is 94 hp. To give plenty of reserve capacity for contingencies and to reduce upkeep to a minimum, a 150-hp. motor was installed. In general, this policy of using large motors for the work has been adopted throughout the station.

Water to the economizer enters at the bottom of the rear header and passes through 396 tubes, leaving at the top of the front header. The relative flow of gas and water is thus counter-current.

Further information regarding the details of construction required by increased steam pressure, as well as features of the electrical part of the station, will be presented in a subsequent issue of the ELECTRICAL WORLD.

Motors and Control for Traveling Cranes

Types of Electrical Equipment Found Suitable with Different Cranes, Current Demand During Typical Operations, and Factors in the Effective Handling of Cranes

BY C. E. CLEWELL

Assistant Professor of Electrical Engineering, University of Pennsylvania

SYNOPSIS.—This article, the eleventh of a series on motor and control applications, contains a discussion of the suitability of variable-speed motors for traveling cranes. Reference is made to the various types of cranes in use, the types of motors commonly employed, the current required by the various motors under operating conditions, and the type of control for such equipment. In connection with control, various methods of braking are explained and a series of simplified wiring diagrams is used to show the typical schemes of connections for hoisting and lowering the load where dynamic braking is included in the control equipment. Reference is also made to the importance of the gearing between the driving motor and the crane bridge itself as a factor in the effective handling of the crane, and to the use of limit switches as a safety factor in hoisting.

THE term "traveling crane" includes several types, as follows: (a) The standard electric overhead traveling crane, where the crane travels upon an overhead framework or structure. In this type three motors are usually required, one of which operates the hoisting device, a second moves the crane as a whole along the runway up and down the factory aisle, and a third moves the "trolley" back and forth along the crane girders. The hoisting equipment is mounted on the "trolley." (b) Gantry cranes, which are similar in general characteristics to (a), but where the crane is operated on tracks at floor level, the crane itself being supported on structural legs. (c) The usual equipment employed in telpherage systems. (d) The jib crane, where a motor is used for driving the hoisting tackle. (e) Electric locomotive cranes, in which a number of motors may be used for driving the various elements. (f) Miscellaneous types, such as charging cranes, skip hoists and the like.

In this article the standard electric overhead traveling crane of class (a) has been selected as the basis of the discussion. As far as the motor is concerned

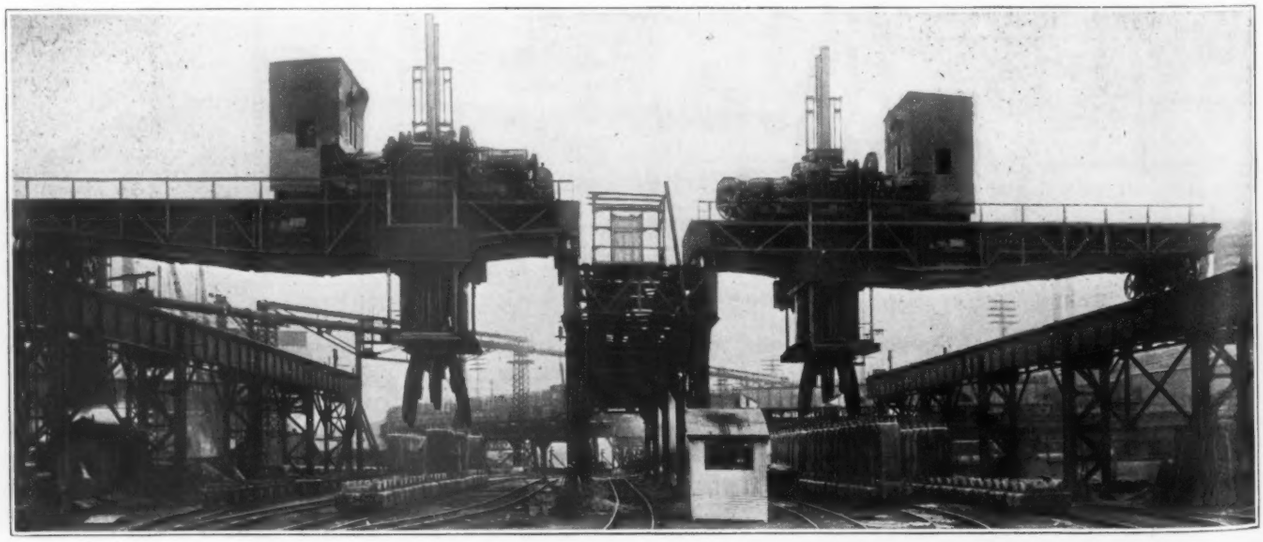
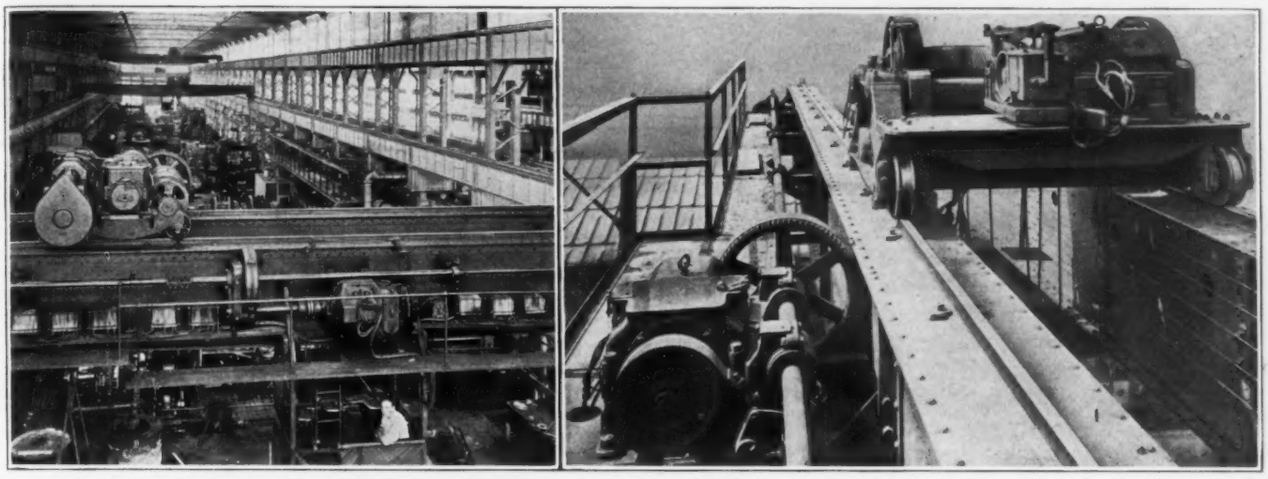


FIG. 1—ELECTRICALLY OPERATED YARD CRANES UNLOADING CASTINGS

for the three elements of the overhead traveling crane the straight series direct-current type is the one usually employed.[1] The speed-load characteristics of the series motor are such that under heavy loads the motor operates at a reduced speed, which is desirable from the standpoint of the supply circuits and generating equipment, while at reduced loads the motor operates at higher speeds and the quick handling of the crane is thus facilitated under such conditions.



FIGS. 2 AND 3—BRIDGE, TROLLEY AND HOIST MOTORS ON TWO TYPICAL CRANE INSTALLATIONS

Where alternating current only is available it is sometimes satisfactory to use alternating-current motors of the slip-ring induction type, which are preferable as to torque and speed variation in comparison with the squirrel-cage induction motor. Neither of these alternating-current motors, however, has such a marked tendency to higher speeds at light loads as the series direct-current motor, and hence it may be desirable in those cases which require wide speed variation to convert from alternating current to direct current, so as to make possible the use of direct-current series motors (see footnote 1). Fig. 3 gives a good idea of one type of (inclosed) direct-current crane motor, while Fig. 10 shows the use of polyphase alternating-current motors for crane service.

Several features in the motors for cranes have received special attention. In the general class of inclosed direct-current motor shown in Fig. 3, for example, rugged construction is apparent. Reliability under the exceedingly severe operating conditions encountered has been secured by careful design of the bearings, so as to insure large and well-oiled bearing surfaces; the frame has been designed for unusual strength; the commutator and brush surface has been made large enough to meet the service conditions; the armature coils are heavily banded and in some motors the overhung portions of the armature coils are supported on shelves; and finally the use of commutating poles, which increase the life of the commutator and contribute to the ease of using the motor for reversing service permits handling sudden overloads without sparking. Similar care has been given to the design of alternating-current motors of the various types.

Graphic ammeter records taken on the three motors of an overhead traveling crane when handling a 30-ton load[2] are shown in Figs. 5 to 8. These curves relate to one set of conditions only, but they indicate clearly the variations in the current requirements, and, moreover, they show that the demands on the various crane motors are likely to vary over wide limits except in those special cases where a fairly well-defined duty cycle is repeated regularly, and possibly also in those cases where a crane is used only occasionally for repair work, as in a power house, where the heating of the motors is sometimes a problem of little or no importance.

Where the duty cycle is subject to fairly close determination the "square-root-of-mean-square" method for ascertaining the correct motor horsepower rating may be used, as fully explained in previous articles. One method employed by the manufacturers is to rate crane motors in brake horsepower on a basis of being able to operate continuously for thirty minutes, starting cold, at the full rated load without any part of the motor rising to any higher temperature than 55 deg. C. above the temperature of the surrounding air. A knowledge of the r.m.s. horsepower required, together with the manufacturer's rating basis, makes it possible to select the motor, whereas in those cases where the duty cycle is not well defined and where the maximum or full capacity of the crane is required at infrequent intervals it becomes more difficult to apply a definite method for the horsepower determination, and a greater degree of judgment must be exercised.

Care must be taken in the application of series motors to see that the maximum speed reached by the motor at light loads is not greater than the construction of the motor armature can stand. Some manufacturers, therefore, tabulate the maximum speeds for the various classes of series-wound crane motors, which must not be exceeded when the motors are carrying the friction load of the crane only. For example, the motors in Fig. 3 are listed at 2100 r.p.m. for this maximum speed, whereas low speed is listed as 550 to 600 r.p.m. and

[1]The classification of cranes is based on an article by A. C. Eastwood, "Standard Handbook for Electrical Engineers," fourth edition, McGraw-Hill Book Company, New York.

[2]Figs. 2 and 3 are reproduced from C. W. Hill's treatise on cranes. Figs 5 to 8 are due to the General Electric Company, Fig. 10 to the Wagner Electric Manufacturing Company, and Fig. 1 to the Crocker-Wheeler Company. Frequent references have been made to the "Standard Handbook for Electrical Engineers" and to bulletins or other data placed at the disposal of the writer by the Westinghouse Electric & Manufacturing Company and the other companies just mentioned.

moderate speed at 725 r.p.m. for this same type of motor.

A simplified wiring diagram showing the principal elements of a direct-current crane controller is shown in Fig. 4. In hoisting, the operation of this controller

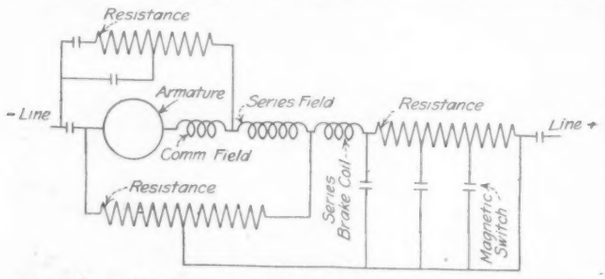


FIG. 4—SIMPLIFIED DIAGRAM OF DIRECT-CURRENT CRANE CONTROLLER

is similar to that of ordinary controllers, since the motor is merely connected to the line through armature resistance, as shown in the upper part of Fig. 9, for example, in which case the upper left-hand resistance is inserted for the purpose of starting up the motor at low speed. In lowering the load of a crane-hoist motor it is necessary to employ some means for braking the load. This may be done by an ordinary mechanical brake, by some form of electrically operated brake or by dynamic braking. The last two types are of interest from the motor or electrical control standpoint.

It is usually the practice to arrange electric brakes so that they exert their braking effect only when no current is being supplied to the motor from the line. As soon as the controller admits current to the motor the brake is released. Of the three types of electric brakes commonly employed (band, disk and shoe) it is the usual practice to furnish the disk brake when the brake is required merely for retarding the momentum of the moving parts, and it is constructed to hold, say, one-half of the full-load torque of the motors. For high retarding power the shoe brake is desirable, and it may be adjusted to hold more or less than full-load torque. When set it is self-adjusting in that any wear in the brake shoes is compensated for in such a way that the air gaps and hence the braking strength are kept constant. The disk brake, however, has an advantage over the other two types in that side strains are equalized as regards the shaft, and, moreover, the effectiveness of the braking does not depend on the direction of rotation, as may be the case with the other two types.

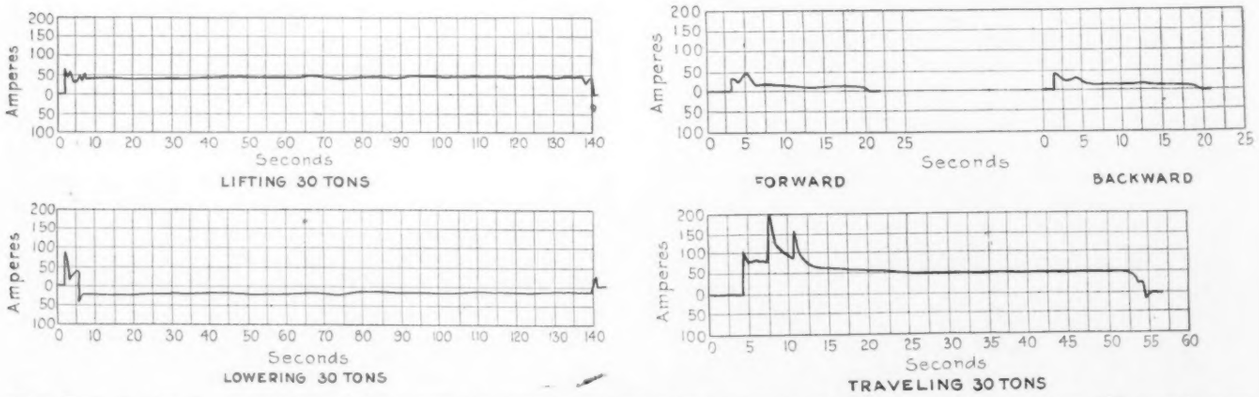
Dynamic braking is especially interesting because it involves some modifications in the controller. Consider, for example, the controller represented by Fig. 4. When the load is lowered the first position of the controller places the armature and the series fields across the supply mains through paths which are in parallel, each path having resistance, as in the third simplified diagram of Fig. 9. An inspection of this diagram shows that these connections place the armature and field winding in parallel, thus essentially making the machine a shunt motor for the time and starting the load at low speed. This first controller position for lowering is sometimes called the "kick-off" position.

As the load is lowered the armature is rotated and the motor is thus converted into a generator, which results in a "dynamic" braking current through the series field tending to stop the motor. By advancing the controller additional resistance may be inserted in the armature circuit, thus increasing the speed of lowering (see the lowest diagram in Fig. 9). Other types of controllers are available, but they differ chiefly in details and in some of the functions they are designed to cover.

THE CROSS BRIDGE DRIVE[3]

While the normal speeds of crane bridges vary considerably, depending on conditions, from 250 ft. to 300 ft. (76.2 m.) per minute, which correspond to about 3 miles to 3½ miles (5.6 km.) per hour, are practical averages based on the speed at which a man can walk down a factory aisle while accompanying a piece of material being transported by the crane. Where very long runs are involved higher gearing is sometimes employed, resulting in speeds as high or even higher than 1000 ft. (304.8 m.) per minute.

A. C. Eastwood (see footnote 1) cites an interesting case where a bridge speed of 500 ft. (152.4 m.) per minute was employed for a certain crane, which performed a regular duty cycle made up of short moves of about 24 in. (0.6 m.) at a time for twenty-four successive times, after which the crane returned to its starting position. This cycle of operations continued for essentially twenty-four hours each day. After this crane was placed in operation it proved to be unsatisfactory because the operator found it almost impossible to stop at the required point, practically always going beyond and then finding it necessary to reverse and



FIGS. 5, 6, 7 AND 8—AMMETER RECORDS FOR AN ACTUAL CRANE WHEN LIFTING, LOWERING, CARRYING LOAD (30 TONS) BACK AND FORTH ACROSS BRIDGE, AND TRANSPORTING ALONG CRANEWAY

[3] "Standard Handbook for Electrical Engineers," fourth edition, p. 1212.

going beyond in the reverse direction. This made several attempts necessary in each case to place the crane in the desired position. To reduce the gear ratio between the bridge motor and the driving shaft would tend to reduce the difficulty of stopping at a fixed point,

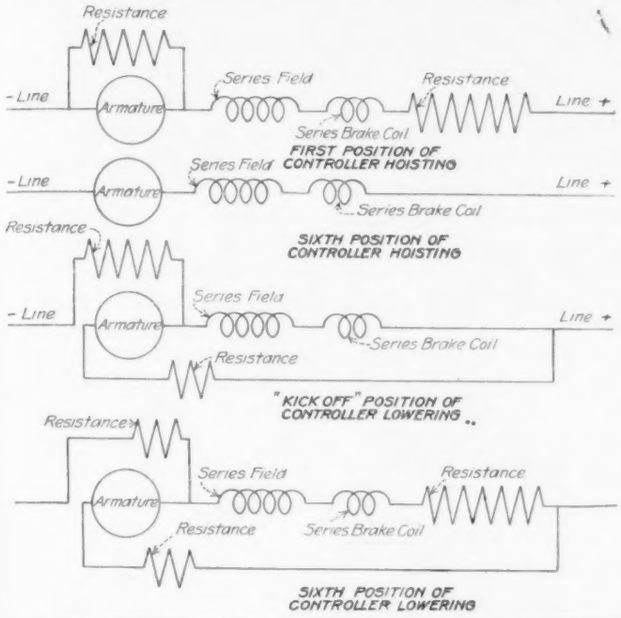


FIG. 9—CHANGES MADE IN CONNECTIONS WITH DIFFERENT POSITIONS OF CONTROLLERS

but theoretically such a reduction would also tend to lower production because of the reduced speed at which the bridge could be moved along the aisle of the workshop.

Nevertheless, the gear ratio was changed so that the reduction was three times as great as the original reduction, with the result that because of the increased accuracy in stopping at fixed points, the production or the output of the crane was increased over 400 per cent in spite of the decreased speed at which the bridge could be moved. This interesting case brings out in the form of a single example the need for careful attention to the gearing problem in crane operation as one of the features in the application of motors to such drives.

Special devices are available as protective features. One of these is the hoisting limit stop or switch,

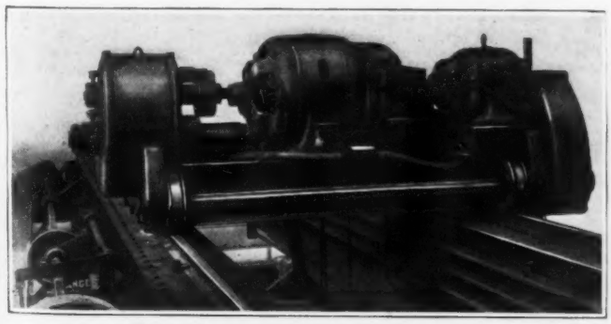


FIG. 10—ANOTHER TYPE OF DRIVE FOR TROLLEY AND HOIST

with which it is made impossible to raise a load by the hoisting motor so as to force it up into the trolley mechanism. One scheme for operating such limit switches is to have them cut off the supply current automatically when the hoisting tackle reaches a certain point and then to insert a dynamic brake circuit of such low resistance that the motor and load are stopped practically at the instant of disconnection.

Panels are also equipped to protect against overloads and prevent injury to workmen making repairs due to the starting of the motors before work is completed.

In conclusion it should be stated that the economies which were shown to be possible when correct applications of motors and control are made to lathes and planers are almost equally possible with the traveling crane because of its importance to production in the handling of materials.

MOTOR CONNECTIONS FOR DIFFERENT SERVICES WITH FOUR TYPES OF MAGNET-SWITCH CONTROL

Characteristics	Reversing, Automatic-Acceleration, Speed-Control, Dynamic-Braking		Reversing, Automatic-Acceleration, Speed-Control	Reversing, Automatic-Acceleration
Form of Controller	1	2	3	4
Hoisting	One series motor or two series motors in series	Two series motors in series or parallel		
Bridge operation	One series motor or two series motors in series	Two series motors in series or parallel	One series motor or two series motors in parallel	One series motor
Trolley travel	One series motor or two series motors in series	Two series motors in series or parallel	One series motor or two series motors in parallel	One series motor

Book Reviews

HOW TO MAKE HIGH-PRESSURE TRANSFORMERS. Second edition. By Prof. F. E. Austin, Hanover, N. H. 46 pages, 211 illustrations. Price, 65 cents.

Several methods of making different types of transformers for high-voltage use are given in this book in simple language. Information is given on the method of procedure for designing and constructing transformers for any special use and on formulas for the calculation of various losses, thus insuring a suitable design.

BUSINESS LAW FOR ENGINEERS. By C. Frank Allen. New York: McGraw-Hill Book Company, Inc. 291 pages. Price, $3.

It was said recently before a large body of men by a speaker of some prominence that every successful business man must be something of a lawyer. Probably of no profession is this more true than that of engineering. The author of this volume, a professor of railroad engineering in one of the most prominent technical institutions in the United States, an engineer of wide experience, a member of the Massachusetts bar and a former practicing lawyer of considerable repute with engineering corporations, has undertaken after years of preparation to give the engineer, as he expresses it, "a sufficient understanding of important fundamental features of law so that he may have some idea of when or how to act himself and when to seek expert advice." The book, which is in two parts, (1) elements of law for engineers and (2) contract letting, seems very complete and goes well into detail without, however, being full of legal technicality. The layman can easily grasp its contents.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

ALLOWABLE LINE LOSS DEPENDENT ON SERVICE

Consideration of Kelvin's Law May Indicate Necessity of Smaller Line Loss Where Energy Is Purchased at Primary Rate

BY R. G. HARRIS

In working out sizes of transmission-line conductors the rule of "10 per cent allowable for line losses" has become so well established that power company engineers sometimes forget that it may not apply when figuring transmission lines for consumers. Although 10 per cent may be satisfactory for the company's lines, where the actual cost of producing energy at the switchboard is something under ½ cent, it is another matter altogether if the energy is being transmitted by the purchaser, who has paid about ¾ cent per kilowatt-hour for it at a high voltage and has to figure in line allowances as well as mechanical efficiencies in his operating charges.

The use of Kelvin's law—namely, that the annual value of the power lost should theoretically equal the annual cost of the copper in the line—as an aid to judgment in finally determining the economic size of wire will very materially change the assumption as to line loss, and the 10 per cent assumption under the conditions mentioned above will generally be found to be very excessive.

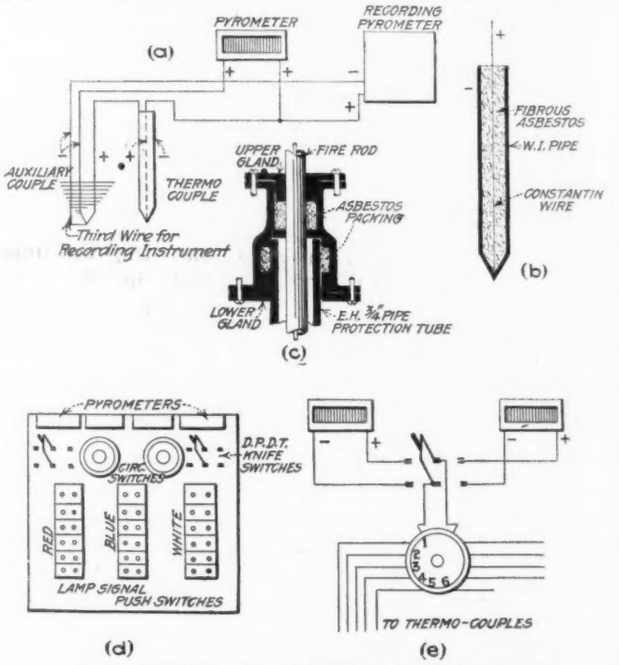
PYROMETER SYSTEM FOR ANNEALING FURNACES

Mounting of Thermocouples, Method of Running Circuits and Provisions for Supervision of Furnace Operation

BY W. P. THOMAS

An indicating and recording pyrometer system that is giving complete satisfaction to both the furnace operator and the metallurgist was installed some time ago by the writer in connection with a battery of six annealing and hardening furnaces. Six indicating pyrometers with the auxiliary equipment are installed on the checkers' bench; the recording pyrometers are situated in the metallurgist's laboratory and signaling lamps are mounted over each furnace to notify the attendant when the temperatures of the furnace are high, low or correct. Three thermocouples are installed in each furnace so that the central and end temperatures can be observed, and so the operator can determine which fuel valve to operate to keep the temperature correct. To avoid the use of too many pyrometers and still not hinder the observation of temperatures, the thermocouples are connected in groups of six to three circular switches, which in turn are connected with double-pole, double-throw switches, as shown in the accompanying illustrations, so that readings may be checked.

A small hole is provided in each furnace where the temperature is desired and the thermocouple centrally attached to a tripod the feet of which rest upon the top of the furnace. What might be called a stuffing box is provided to seal the space between the thermocouple and the furnace casing, the construction, (c) in the accompanying illustration, being such that the thermocouple can be raised or lowered by adjusting the tripod attachment. This arrangement also makes it easy to remove the thermocouples for renewal or inspection. To prevent the leads of the thermocouples carbonizing, owing to heat escaping through the holes in the top of the furnace, long enough thermocouples are used so that their upper ends can be bent at an angle of 90 deg., bringing the cold ends 1 ft. (0.3 m.) from the



SOME FEATURES OF PYROMETER INSTALLATIONS

(a) Method of connecting thermocouple with instruments. (b) Details of thermocouple construction. (c) Protection details of stuffing box. (d) Checkerboard. (e) Circular switch shown in (d).

middle of the furnace, where the circuits run into conduits leading to the checker's bench and metallurgist's office.

All of the wires, which have asbestos insulation, are installed in iron conduit. The checker's bench being centrally situated, a 2-in. (5-cm.) conduit was installed from it to a pull box placed between the third and fourth furnaces. From this point to the second and fifth furnaces 1½-in. (3.8-cm.) conduit is used and reduced to 1 in. (2.54 cm.) where it extends to the first and sixth furnaces. From the main conduit ¾-in. (1.9-cm.) conduit extends above the furnaces to points over the thermocouples, where ¾-in. (1.9-cm.) conduit tees equipped with porcelain bushings are provided. One-and-one-half-inch (3.8-cm.) conduit is used between the checker's bench and the metallurgist's laboratory.

AUTOMATICALLY OPERATED SYNCHRONIZING STATION

Arrangements by Which Two Transmission Lines May Be Automatically Connected at a Point Remote from Any Station or Substation

The Iowa Railway & Light Company of Cedar Rapids has two 13,200-volt transmission lines which it is desirable to operate in parallel, yet which join each other at a point where it is frequently desirable to open the circuit. Moreover, it is not desirable to interrupt service on either line to bring about the paralleling of the two sections after the line has been opened. A substation simply for the purpose of connecting the lines together at this point did not seem to be justified. To meet this condition, therefore, the company's engineers have installed an automatic synchronizing station and a set of watt-hour meters, equipped with ratchets, to record the interchange of power between the two sections of the system.

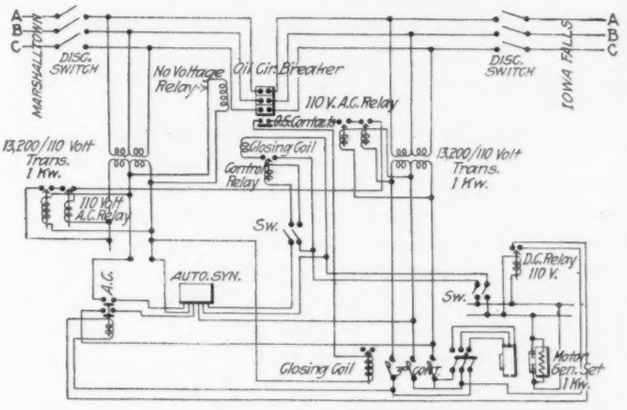


DIAGRAM OF CONNECTIONS IN AN AUTOMATIC SYNCHRONIZING STATION BETWEEN TWO HIGH-TENSION LINES

The apparatus consists of two sets of 13,200/110-volt, 1-kw. standard transformers, two sets of 110-volt steel-mill type relays, an automatic synchronizing device, a 1-kw. motor-generator set, an oil circuit breaker and a few additional relays. The two sets of 110-volt steel-mill-type relays are connected across the phases of the secondary sides of the transformers, which are in turn connected in the 13,200-volt circuits. The contacts on these relays are in series, therefore the closing of all relays is accomplished when all phases are energized. When all of these series contacts are closed the small motor-generator set is started. It supplies energy through its direct-current unit, when it comes up to full voltage, to close the direct-current relay shown in the accompanying illustration. This in turn permits alternating-current energy to flow to the synchroscope.

The synchroscope, manufactured by the Westinghouse Electric & Manufacturing Company, consists essentially of two solenoids acting on cores hung on the opposite ends of a rocker arm. The solenoids are connected so that the right-hand end of the rocker is at the extreme lower end of the stroke when the electromotive forces to be synchronized have no phase difference and is at the upper end of the stroke when the phases are in opposition. This causes the rocker arm to oscillate up and down. When the right-hand end of the rocker arm approaches the lower end of its motion with less than a predetermined speed the contact closes the circuit of an auxiliary relay, which in turn closes the circuit operating the closing coil of the main oil switch. The closing of the contact occurs before synchronism by a predetermined length of time sufficient to permit the main switch to complete the circuit exactly at the point of synchronism. The synchronizer does not make contact at all unless the difference in speed of the two machines at the different ends of the line is less than a predetermined amount.

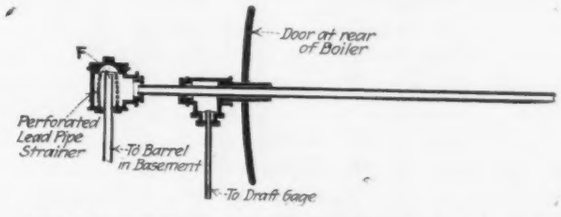
The contacts in the synchronizer at the oil switch are closed when the oil switch is open, and vice versa, to permit starting and stopping of the motor-generator set as desired. For protection against single-phase operation the no-voltage release coil is connected to all phases. The oil switch is not arranged for tripping on overload, the lines being protected at other points against difficulty from this source. The action of the alternating-current relay, which is operated by the motor-generator set, is analogous to the action of an operator before a switchboard plugging in a synchronizing receptacle.

This apparatus, together with the metering equipment, is installed out in the middle of a cornfield and takes care of itself entirely, except for a visit from an attendant about once every three months. The installation was worked out for the Iowa Railway & Light Company by John M. Drabelle, the company's electrical engineer.

OUTFIT DESIGNED FOR TAKING CONTINUOUS FLUE-GAS SAMPLES

Bonus Paid to Operators on CO_2 Present Is Determined by Use of Device That Collects Gas Over an Entire Eight-Hour Shift

After having tried a number of methods of determining the percentage of CO_2 in flue gases at its plant, the Bloomington & Normal Railway & Light Company of Bloomington, Ill., has developed the apparatus shown herewith. The company has installed an outfit of this character on each boiler in its plant. This apparatus in operation takes a continuous sample of the flue gas for eight hours after it is started. The plant is operated on eight-hour shifts, and at the end of each shift the gas is sampled in an Orsat set for CO_2, and occasionally for O and CO. The record of the result is made on the power-plant report, and also on a bulletin board in the boiler room, to show the comparative record of each boiler and each fireman for the different shifts.



DETAIL DRAWING OF FLUE-GAS SAMPLING APPARATUS

The water pipe used for filling the tank is near the bottom of the barrel so that water while filling the barrel shall not disturb the oil seal which is used over the water. When using an oil seal the CO_2 is generally 1 per cent higher than without it, because the oil prevents the escape of air and other gases which are in the

water into the boiler-gas sample under slight vacuum. All samples taken by this apparatus are tested by an efficiency man, the samples being received from the tank in 4-in. (10.2-cm.) gas stopper bags such as are used in stopping gas mains. The time required for filling the tank with water is three minutes, and about three minutes is required to run a sample through the Orsat machine.

The outfit installed in the company's plant has been in operation for some time with good results. The principal difficulty with an arrangement of this kind is in keeping the pipe lines free from a deposit of fine ash which is likely to clog them. The bonus which the boiler-room operators are paid on CO_2 in combustion gases averages about 12 per cent.

FIREPROOFING TOWER LEGS TO SAFEGUARD SERVICE

Legs Are Incased with Concrete to a Height of 40 Ft. Above the Ground—Description of Method of Reinforcing

At the Margaret Street substation of the Springfield (Mass.) street railway a steel tower has been built to hold one end of a 66,000-volt transmission span across the Connecticut River, over which the Turners Falls Power & Electric Company is to supply energy to the railway system. A special feature of this tower is the fireproofing of the legs to a horizontal cross-section of 12 in. by 16 in. (30.5 cm. by 40.6 cm.), illustrated herewith.

The tower legs are of structural steel and are each incased with concrete to a height of about 40 ft. (20.2 m.) above the ground, thus clearing the maximum vertical range likely under any circumstances to be reached

TOWER LEG INCASED IN CONCRETE

by arcs or hot gases in case of oil-switch trouble at the substation adjacent to the tower. The concrete is reinforced with a loop of wire mesh surrounding the lattice work of the tower leg in each case. An outdoor substation equipment with transformers and switches occupies the area below the tower, which requires heavy bracing to serve as the span anchorage, as shown.

MECHANICAL SOOT BLOWERS MAKE 15 PER CENT SAVING

Installation in an Iowa Plant Makes the Jobs of Firemen More Pleasant and Enables Them to Keep the Boilers Cleaner

After one year's experience with mechanical soot blowers, Charles W. Smith, chief engineer for the Iowa Falls (Iowa) Electric Company, has reached the conclusion that the devices have proved themselves a good investment. The installation consists of three sets of Bayer type B cleaners on one 550-hp. and two 410-hp. Edge Moor water-tube four-pass boilers. Before these cleaners were installed the company was using the old hand-cleaning method. This method was expensive and unsatisfactory, costing $840 a year. Practically all of one man's time was required, and it was found that there were few men who would stand in front of a hot boiler and blow every tube. Some tubes would be skipped, with the result that the boilers were never all clean. In fact, it was practically impossible for a man to hold a steam lance with full 175 lb. per sq. in. (12.3 kg. per sq. cm.) pressure on the line. After the new cleaners were installed it took two months to get the caked soot off the tubes which had grown there owing to the use of wet low-pressure steam before the mechanical cleaning system was used.

Several points in favor of the mechanical cleaning have been apparent. The main feature is that in blowing the soot it is possible to use full boiler pressure and do better work. With the old system the tubes were blown once every twenty-four hours. Now they are blown twice on every shift, and, moreover, the services of one man have been entirely dispensed with, thus making him available for other work.

Mr. Smith stated that these cleaners had effected a 15 per cent reduction in coal burned and had occasioned no maintenance expense. One pint (0.5 l.) of oil has been used on the swinging joints. Thus far the valve seats have not required grinding.

USE OF INSULATORS TO PHASE 66,000-VOLT LINE

A Novel Method of Finding if Proper Phase Relation Existed in Locality Where Potential Transformers Could Not Be Employed

A novel method of phasing out a 60,000-volt line was employed by the Southern California Edison Company recently when it became necessary to join the ends of an open loop. Potential transformers could not be used because the phasing-out point was remote from any station or instrument equipment. Suspension insulators were therefore employed, as explained in the following paragraph.

Three strings of five units each were hung on the wires of one end of the loop in such a manner that the lower ends of the strings could be swung against the three wires of the other end of the loop. One string would draw a spark about ¼ in. (6.2 mm.) long while the other two drew sparks more than 1 in. (25.4 mm.) long, showing that they were out of phase with their corresponding wires. These two wires were reversed and the loop closed through the pole top switch without disturbance.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

INCREASING BUSINESS ON SMALL-POWER MACHINES

Through Co-operation with Local Manufacturers' Agents Considerable Load Has Been Placed on Southern Company's Lines

The commercial department of the Birmingham Railway, Light & Power Company has been giving considerable attention recently to the development of small power business. A careful analysis was made of the market to determine which appliances offered the best advantages, and the campaign started, concentrating on these selected appliances.

The Birmingham company does not sell electrical appliances, and it was therefore necessary to secure the co-operation of the local agents in the district handling the various appliances. These agents were naturally enthusiastic over the plan and have taken hold and sold more small power devices than have ever been placed on circuit in that community before.

A large number of vacuum cleaners have been sold and a great many washing machines, vulcanizers, special shoe machines, refrigerating machines, dough mixers, etc. Coffee mills, meat grinders and peanut-butter makers have also been very strong, twenty-six peanut-butter machines having been sold in the last four months on extra meters, with all energy billed at the lighting rate. A short campaign on washing machines was also very successful, six washers having been disposed of in one day in spite of the fact that Southern cities have not yet broken from the negro washerwoman habit and taken to the modern method.

The result for the company has been most profitable and satisfactory. The active co-operation of the manufacturers' agents has reduced the company's responsibility and work to the minimum and at the same time organized an extensive selling force of expert men who have proved most effective.

POWER MEN TURNED TO ON SMALL APPLIANCES

In Certain of the Doherty Properties Sales Forces Are Thereby Kept Intact at a Profit to the Companies

Conditions in these war times are bringing about some interesting changes in the work of many central-station selling men. Not only is there trouble in securing fuel, but many companies after waiting months for new generating equipment have had to relinquish it to the government and see no possibility of increasing their capacity. The result has been that frequently power salesmen have had to discontinue the development of industrial business from the sheer impossibility of furnishing the necessary service.

In many cases it has been recognized that these power men could meet the situation by turning their hand to the sale of meat grinders, coffee mills, drink mixers and the innumerable small appliances which are salable to the home, store and office; in fact, anything else that may be sold at a profit and provide the type of off-peak load at lighting rates which at such a time is desirable.

In three of the Doherty properties—namely, Warren, Mansfield and Massillon, Ohio—the power men are paying not only their salaries but a profit to their companies by the sale of such equipment. At the same time they are selling rectifiers, shafting, flywheels, pulleys and anything else along these lines which will show a merchandising profit and give service to the customer.

The salesmen of the Doherty organization are now all operating on a salary plus commission basis, which demonstrates whether or not the man is profitable. There is, therefore, no expectation of reducing the size of any of the local sales departments, but rather of concentrating the effort on the sale of appliances which will show a merchandising profit and not involve any additional peak load.

CARRYING CURTAILMENT POLICY TO EXTREMES

With Existing Delivery Situation, Interest Saving by Carrying Lower Stocks May Be More than Offset by Customers' Inconvenience

An example of the extremes to which a curtailment policy in the central station's new-business department may be carried is instanced by a New England jobber. A group of central stations under the management of a banking syndicate is at present purchasing electrical appliances in very small lots. Records are kept of the assignment of these appliances to the different companies under common management, one company being supplied with a certain class of appliances like percolators, another with heating pads, a third with sewing-machine motors, and so on. When a customer in any company desires to purchase an appliance not carried in sufficient stock locally the local manager consults his list and sends an order to the company carrying that particular equipment for early delivery. In due course the order is filled or an article sold on the spot replaced. In discussing this policy, the jobber pointed out that while it enables a minimum stock to be carried among a group of central stations, it is difficult to render adequate service to the public in this way.

The cost of sending appliances by parcel post or by express, with present-day lack of speed in transportation, tends to offset the saving effected in interest charges on appliances carried locally and to inconvenience the buying public perhaps more than is necessary in view of the off-peak character of much appliance service in relation to other demands upon the

plant. Even the local dealer does not benefit from this policy unless the central-station manager sees fit to fill orders from the retailer's stock in a co-operative spirit.

ELECTRIC INDUSTRIAL TRUCKS AT TERMINALS

Inasmuch as the Storage Batteries Are Charged During the Night, This Service Furnishes an Off-Peak Station Load

As evidence of what the electric industrial truck can do to reduce congestion at railroad terminals the accompanying illustration is given. Eleven large trunks are here shown being taken away from an Eastern rail-

ONE TRUCK EASILY CARRIES ELEVEN LARGE TRUNKS

road ferry station at one time. One advantageous feature of this load for central stations is that a large part of it is off-peak—the battery charging being done during the night.

SPECIAL ILLUMINATION DEMONSTRATION ROOM

Designed to Aid in Showing Prospective Customers the Latest Developments in Efficient Lighting

The Harrisburg (Pa.) Light & Power Company has recently installed under the salesroom a special illumination demonstrating room, intended to aid in showing prospective or present customers the latest developments in efficient illumination. A wide variety of lamps, reflectors and fixture equipment has been installed, so that it is possible to demonstrate office, factory, store or window lighting under varying conditions.

It is not the intention of the Harrisburg electric department to compete with the local supply dealers now selling fixtures and reflectors to commercial and industrial customers. The fixture manufacturers, however, have co-operated in the equipment of this room with samples of the latest models, and fixtures will be sold at a profit to customers who come to the company for advice in illumination matters. This equipment, the company feels, places it in a position to give far more assistance to the consumer than the average electrical supply dealer can afford.

LIGHTLESS NIGHTS IN HYDROELECTRIC TERRITORY

Conservation of Fuels Shown to Be the Assured Result from the Widest Use of Energy Generated by Water Power

The Utah Power & Light Company, Salt Lake City, Utah, which operates with hydroelectric power, is running the advertisement here reproduced, with the thought of indirectly educating the public to the inadvisability of observing "lightless nights" in hydroelectric territory. "Lightless nights" were instituted not to curtail electric lighting company revenue, but to conserve the supply of fuels. Where water power is used no energy is conserved by turning off the lights—rather is it wasted. In this instance the company urges the widest use of electricity, so that fuels will be used less and the supply thereby conserved.

ELECTRICITY'S PART IN FUEL SAVING

So serious is the coal shortage throughout the United States that it has become the patriotic and imperative duty of each individual to aid to the utmost in the conservation of commercial fuel.

This can best be done by the use of Electricity, generated solely by water power.

The generating of hydroelectrical energy requires no fuel.

Even the water turning the wheels of the enormous power plants operated by this company is not consumed or contaminated, but returns at once and without diminution to its natural channels. During the present year—1917—the Utah Power & Light Company generated 500,000,000 kilowatt-hours of electrical energy, which in its many uses is doing work in the mines, factories, farms and homes of this great intermountain territory that otherwise would have necessitated the use of 1,000,000 tons of coal. It would have required 25,000 coal cars and more than 500 locomotives to have transported this vast quantity of coal to the consumers.

To curtail your use of electric service, or to fail in utilizing electricity to the very fullest extent in business and in your home, is to fail in doing your full share to support the government's fuel conservation policy.

There are many uses in every business and in every home for electric service where a direct and material saving of coal will result.

Electric cooking and electric ironing are important factors.

In 2200 residences, hotels and restaurants throughout this company's territory electric service is being used to-day for cooking. And by using electricity for this purpose these 2200 consumers are saving the government 30,000 tons of coal annually.

If 22,000 consumers used electricity for cooking the saving would be 300,000 tons of coal annually.

In practically every industrial pursuit in the intermountain West electricity is simplifying manufacturing processes, abolishing wasted effort, increasing production, cutting operating costs—and SAVING FUEL.

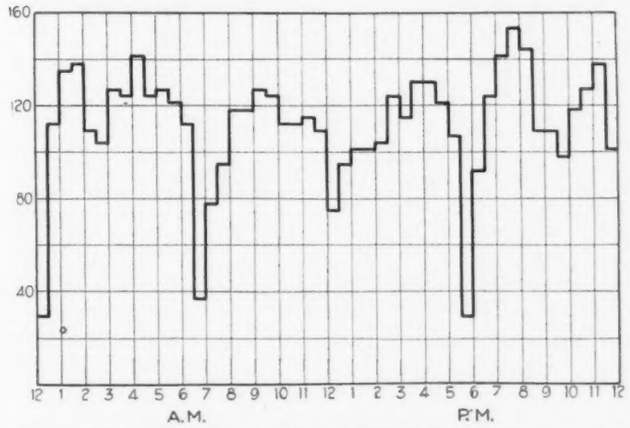
UTAH POWER & LIGHT COMPANY

Efficient Public Service

LOAD CHARACTERISTICS OF AUTOMOBILE TIRE FACTORY

Assembled Data on the Machines Installed, on the Characteristics of Demand and on Unit Energy Consumption

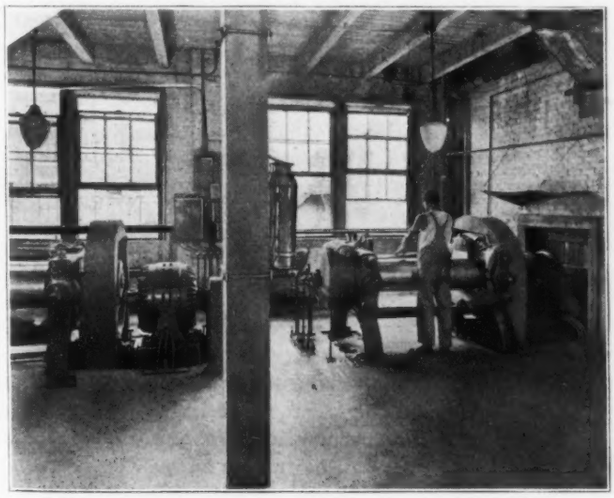
The installation of the Ehman Tire & Rubber Company of Chicago is an example of a medium-sized tire company from which data of a generally applicable character may be taken. All of the service is supplied at 220 volts, three-phase, 60 cycles, from the lines of the



LOAD CURVE OF TIRE FACTORY PRODUCING 500 TIRES A DAY (HALF-HOUR READINGS)

Commonwealth Edison Company. It is all utilized as alternating current except that energy required to operate a 90-hp. calender. Direct current for this machine is supplied by a 100-kw. rotary converter operating from the alternating-current supply. One calender is driven by an alternating-current motor, a departure from usual practice. Lighting is supplied through an auto-transformer connected so that all service will come through one meter and thus give the tire company the benefit of receiving a simultaneous maximum demand.

The table herewith is a complete record of the electrically driven apparatus at the plant of the Ehman company. It shows the connected electric load exclusive of lighting to be 750 hp. The curve reproduced shows the uniform character of the company's load. The maximum demand occurred between 7:30 p. m. and 8 p. m. and amounted to 153 kw., giving a demand factor of 27.2 per cent and a load factor of 74.7 per cent. The peak was only a few kilowatts above the usual demand. The total energy consumed in September, the month in which the demand curve was made, was 52,200 kw.-hr. During this month the company's output amounted to 500 tires a day, the tires including all of the more common sizes. It can also be shown that the energy consumption per tire was only 3.48 kw.-hr. and amounts to only a very small fraction of the tire cost. With the exception of three buffers and one cement mixer, for which the data could not be obtained, General Electric motors are used.



MOTOR-DRIVEN MILLS AND CALENDERS

DATA ON MOTOR APPLICATIONS

Number of Units	Type Machine	Type of Drive	Manufacturer	Size of Motor in Hp.
2	Mill	Gear	Birmingham	100.0
1	Mill	Gear	Birmingham	50.0
1	Mixer	Gear	Birmingham	75.0
1	Mixer	Gear	Birmingham	75.0
1	Hydraulic pump	Gear	Davis	7.5
1	Calender	Gear	Birmingham	50.0
1	Calender	Gear	Vaughn	90.0
2	Mills	Gear	Vaughn	35.0
1	Mill	Gear	Vaughn	100.0
1	Mill	Gear	Farrell	40.0
1	Mill	Gear	Birmingham	100.0
1	Tuber	Belt	Allen	5.0
1	Elevator	Belt	Otis	7.5
3	Buffers	Belt	.....	5.0
1	Labeling	Gear	.....	0.1
1	Experimental mill and calender	Gear	Vaughn	5.0
1	Cement mixer	.....	.....	5.0
2	Cove machine	Guard	Akron Rubber Mold	5.0
1	Cleaner	Belt	.....	3.0
1	Air compressor	Belt	Curtis	35.0
1	Bias shears	Belt	Birmingham	5.0
1	Tube wrapper	Belt	Akron Rubber Mold	2.0
1	Treadmill	Gear	Adamson	15.0
1	Rotary converter	.....	.....	100.0
Total.....				750 hp.

PRESENT-DAY VALUE OF STOCK OF MOTORS

Georgia Company Sells in Eighteen Months 175 Motors, Aggregating 7140 Hp., or an Average of 41 Hp. per Machine

During the last eighteen months the Georgia Railway & Power Company has sold to its various hydroelectric customers 175 electric motors, aggregating 7140 hp., the cost totaling $101,667. The greater portion of these motors were furnished from the company's stock.

In the opinion of the sales department of the company, this stock has been a valuable asset in that some very substantial power business has been placed on the company's lines which might have been lost had not the motors been immediately available for emergency purposes. Moreover, new business has been secured owing to the fact that motors were delivered promptly, where, on the other hand, the customer might have been delayed through long deliveries from the manufacturer.

While the number, horsepower and value of motors handled by the company run into big figures, they do not include sales made by the motor manufacturers direct to customers. In the same period the manufacturers sold approximately 31,500 hp. in motors, aggregating $662,000 in value. Calculations based on motor sales from company stock indicate the following average horsepower per motor: 220-volt, 19.8 hp.; 550-volt, 41.5 hp.; 2300-volt, 68 hp. The grand average size is 41 hp. per motor.

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Starting Rotary Converters When Connected to Transformer Secondaries.—F. D. NEWBURY and M. W. SMITH.—When rotary converter transformers are permanently connected to the slip rings, starting from the direct-current end requires a larger starting current and the torque is not so good as with an arrangement where the alternating-current circuit is open. The authors analyze these conditions in this article.—*Electric Journal,* January, 1918.

Lamps and Lighting

A New Spherical Photometer for Incandescent Lamps.—The introduction of gas-filled lamps of novel shapes has made necessary a new style of photometer which will measure, not the mean horizontal luminous intensity, as in the old types of lamp, but the mean luminous intensity in space. With this end in view, a spherical photometer made of zinc sheets, polished on the inside, has been developed. An opening closed by a small panel permits the introduction of the lamp. Behind a disk of opal glass closing an opening on the horizontal surface of the apparatus, in an oblique direction from the lamp, is a Lummer-Brodhun photometer. In a tube connecting with the latter is another luminous source, also furnished with a disk of opal glass. The method of making the tests is to bring the lights derived through the two disks to equal values. How this is done is fully explained and the apparatus is illustrated by diagram and photograph.—*Revue Générale de l'Electricité,* Nov. 24, 1917 (abstracted from *Elektrotechnische Zeitschrift,* April 5, 1917).

Generation, Transmission and Distribution

The Properties of Electrolytic Copper.—B. WELBOURN.—The author of this article presents tests that were made on an experimental span under working conditions with different cross-sections of copper conductors and different numbers of strands.—*Journal of (British) Institution of Electrical Engineers,* December, 1917.

Suppression of Arcs Due to Accidental Ground.—M. H. COLLBOHM.—Service disturbances or interruptions in transmission systems are in most cases occasioned by grounds or short circuits on the power line through outside influences, such as lightning, sleet or wind. Effective means for eliminating such causes cannot, therefore, be provided within the system itself and only relief in suppressing their bad effects on the system can be sought. Different kinds of equipment are in use for the elimination of ground trouble, depending upon whether the system operates with the neutral point isolated, dead-grounded or grounded through resistance. The author describes the kinds of equipment used in the three types of systems cited and points out their distinguishing features and their influence upon service. In this connection potential stresses, mechanical stresses, reliability of operation, attendance required, detection of faulty lines, advantage of ground rheostat for line testing and emergency construction and comparative costs are taken up.—*Electric Journal,* January, 1918.

Aluminum-Iron-Rope Cable for High-Tension Transmission Lines.—A certain power transmission line in Germany designed and planned in 1914 could not be completed along the lines contemplated because of the shortage of copper. It was found impossible to substitute iron wire because the supports (already in place) had not been built strong enough to withstand the great stresses caused by the heavier iron wire. Other reasons, which are withheld from public discussion, prevented the use of steel-cored aluminum wire. The final solution of the problem, as reported by E. G. Fischinger of Dresden in the *Elektrotechnische Zeitschrift,* is as follows: Oil-saturated paper twine of 3.5-mm. diameter is wrapped with a strip of galvanized iron 7.5 mm. wide and 0.3 mm. thick in a "right-hand" spiral. Around this are wound in closely wrapped left-hand spirals six galvanized-iron wires 3.9 mm. in diameter. The iron core is then covered by twelve aluminum wires of 4.1 mm. diameter wound in a long-pitch right-hand spiral. The oiled paper is burned out as soon as the winding is completed, leaving a hollow iron-aluminum cable which has a wide range of elasticity, adapting it to severe wind and temperature stresses. The cable has a tensile strength of 6790 kg. (30 kg.-mm.^{2}), or nearly one and a half times that of a pure aluminum cable.—*Schweizerische Bauzeitung,* Dec. 15, 1917.

Traction

Heating of the Armature in Traction Motors.—LEONHARD ADLER.—The author proposes to estimate the extent of armature heating by the measure of the resistance, a method much more rapid, simple and practical than the thermometric method. It is not necessary to measure the resistance of all the armature coils, but only of a portion of those in identical conditions. With high-powered motors it may be well to raise some of the brushes and insulate them by bands of presspan, though this precaution is not necessary with tramway motors, which usually have wave windings. One advantage of the method advocated is that it can be used when the tractors are in motion, which is impossible with the thermometric system. Resistances as low as 0.001 ohm can be measured by the Thomson apparatus.—*Revue Générale de l'Electricité,* Nov. 24, 1917 (abstracted from *Elektrotechnische Zeitschrift,* June 28, 1917).

Further Railroad Electrification Important.—F. H. SHEPARD.—The author points out in this article that electrical equipment provides a most effective way of increasing transportation capacity.—*Electric Railway Journal,* Jan. 5, 1918.

Installations, Systems and Appliances

Steam Central Station for Hanover, Germany.—The much-discussed plans for a single central station for all Germany have been brought nearer completion by the beginning of work on a state-owned power station in Hanover. This station will be operated by steam turbines of 10,000-kw. rating each—three of these turbines being installed to start with. It will form the connecting link between the two finished stations at Dörverden (Weser River) and Minden (Rhine-Weser Canal) and the two stations now nearing completion on the upper Weser and the Main, all of which are of the hydro-electric type. The completion of the Hanover station will form the last link of the chain reaching from the upper Main River to the North Sea coast, covering all of Germany west of the Elbe. The Hanover station is designed for three stages of development—50,000,000 kw.-hr., 90,000,000 kw.-hr. and 120,000,000 kw.-hr. The estimated construction cost will be 13,000,000 marks ($3,250,000), and maintenance costs $750,000 annually.—*Schweizerische Bauzeitung*, Dec. 15, 1917.

Electrophysics and Magnetism

Some Electrical Properties of Silver Sulphide.—GEORGE W. VINAL.—Silver sulphide may be prepared in the form of short wires or thin strips like a metal. The wire, which must be drawn hot, has been found to conduct electricity like a metal of high specific resistance and has a practically zero temperature coefficient. The strip of sulphide, rolled at room temperature, has a large negative temperature coefficient and shows both metallic and electrolytic conduction at the same time. It has a volt-ampere curve characteristic of a pyro-electric conductor. The resistance of these strips has been examined with both alternating and direct current, with the result that the alternating-current resistance was nearly always found to be higher than that with the direct current, and the passage of a small alternating current of a frequency as low as 60 cycles increased temporarily the resistance of the sulphide, while a small direct current produced the opposite effect.—*Bureau of Standards, Scientific Paper No.* 310.

Units, Measurements and Instruments

A Method for Testing Current Transformers.—FRANCIS B. SILSBEE.—A general method is outlined in this paper for the determination of the ratio and phase angle of current transformers in terms of the constants of previously calibrated standard transformers of the same nominal ratio. It has been shown that such methods are essentially more sensitive, or, conversely, may be used with much less sensitive instruments, than the laboratory methods now in use for the absolute determination of the ratio and phase angle of a single transformer. Two of the most convenient of the many possible modifications of the general method are described in detail. It is hoped that the methods will be found useful in commercial plants where delicate laboratory equipment is not available and where large numbers of transformers must be tested rapidly and with moderate accuracy.—*Bureau of Standards, Scientific Paper No.* 309.

Telegraphy, Telephony and Signals

Theoretical Calibration of Condenser Transmitter.—I. B. CRANDALL (Research Laboratory of the American Telephone & Telegraph Company and Western Electric Company).—The object of this paper is to complete as far as necessary the mechanical theory of the condenser transmitter. The mechanism of air-damping has been determined, and formulas have been obtained from which practical calculations can be made. A complete theoretical calibration of a condenser transmitter has been given which is consistent with the experimental calibration and which does not disturb the uniform frequency-sensitiveness characteristic of the instrument except at frequencies very near zero. The principles have been given for the design of air-damped systems of maximum damping and condenser transmitters having rigorously uniform sensitiveness over an extended range of frequencies, including zero. —Presented before American Physical Society, Dec. 28, 1917.

Measurement of Continuous Waves.—A discussion on how to calibrate a wavemeter that is recommended in the article.—*Wireless World*, December, 1917.

Miscellaneous

Industrial Specialization of Engineers.—E. PIERNET. —A plea for the establishment of technical high schools after the model of the Ecole Supérieure d'Electricité of France and the German "Hochschulen." The results due to the latter as impressed upon the author in the course of many years' employment in a large metallurgical plant on the Saar are outlined.—*Revue Générale de l'Electricité*, Nov. 24, 1917.

Effect of Brick Arch on Smoke Abatement.—An article on the principles underlying methods of securing complete combustion.—*Power Plant Engineering*, Dec. 1, 1917.

A New Insulating Material.—A new type of insulating material for which special properties are claimed is described. Besides having good insulating properties, it can be molded to any desired shape and cut or worked either by hand or machine. It is also practically incombustible, non-absorbent and does not have to be varnished. It is considered suitable for many electrical applications for which porcelain, marble and various vulcanized preparations are at present employed. The cost is also stated to be relatively low. The material is said to have the following constituents:

	Per Cent
Powdered flax	51.7
Sifted mica	14
Mineral rubber	20
Resin	1
Rubber solution	10
Flowers of sulphur	3
Selenium bisulphide	0.3

It is pointed out that the selenium bisulphide is used only as a suitable binding material, which facilitates the combination of the other ingredients and evaporates when the substance is left in the air after mixing. Carbon bisulphide may also be employed. The other substances are all capable of close mixing. The mineral rubber recommended is a soft mineral deposit which occurs in certain oleaginous schists. The proportions of the materials may be varied within certain limits, according to the use to which the material is to be put. After the substance has been dried it can be softened by being immersed in a steam-jacket vessel. When thus reduced to the plastic state it can be compressed into any desired form.—Abstracted from the *Revue Générale d'Electricité* in the London *Electrician*, Dec. 7, 1917.

Scientific and Industrial Research

A Department Devoted to Interchange of Ideas, Investigations Contemplated, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF

Cornell University, Ithaca, N. Y.

Summary of Investigations, Available Apparatus and Research Suggestions

INVESTIGATIONS UNDER WAY OR COMPLETED (RESEARCH WORK REPORTED SINCE DEC. 15)*

CONDENSERS, ABSORPTION IN.

The absorbed charge is allowed to flow continuously through a sensitive shunted galvanometer; simultaneous readings of deflections and time are noted. It is then possible to plot discharge current with time of flow and determine, with a planimeter, the integrated value of $\int i dt$ between chosen time limits (in certain cases the time of flow is ten hours or more). The absorbed charge is studied as a function of the time of charge and of the charging voltage. Results are expressed graphically. A striking result is that the absorbed charge may be hundreds of times greater than a computed charge calculated from $hQ=CV$, where V is the steady applied voltage and C the capacity as measured on 60-cycle alternating current—*L. Pyle, Washington University, St. Louis.*

CORE LOSS AT HIGH FREQUENCIES.

For the purpose of measuring the losses due to eddy currents and hysteresis, two toroids, both being alike in every respect except that only one contains a specimen of the iron whose losses were to be determined, were connected in series with each other in the secondary of an oscillating circuit. Each of these toroids was placed in a separate calorimeter. If the heat capacities of the calorimeters as well as of the toroids are the same and the I^2R losses in the winding of each toroid are equal, then the heat produced by the specimen of iron in one calorimeter may be balanced in the other calorimeter by means of a direct-current heating coil. The Chaffee gap was used as the source of the oscillations, and the Braun tube was to obtain the oscillograms. The experimental results indicate: (1) that the loss per cycle per cubic centimeter decreases with an increase in frequency; (2) that there is a non-uniform distribution of the magnetic flux due to the "skin effect" produced by the eddy currents.—*C. Nusbaum, Harvard University.*

CORONA (DIRECT-CURRENT), INFLUENCE OF SPARK ON.

A spark gap in series with a discharge tube affects the positive and negative corona in very characteristic ways, the changes being due to intermittent currents. A hot-lime cathode tube has been developed and used in observing the weak pulsating currents which pass through the spark and the corona tube. Evidence can be given in favor of the view that the corona resembles the arc discharge. An attempt at an explanation of the pulsating current has been made.—*S. F. Crooker, University of Illinois, Urbana.*

CORROSION.

Corrosion of non-ferrous metals in sea water and corrosion of condenser tubes in service on land. The inquiry will later be extended to non-ferrous metals under atmospheric conditions.—*Capt. Bengough, Imperial College, London, England.*

FURNACE, ELECTRIC.

Heat is generated by contact resistance between specially shaped graphite parts. An endeavor is being made to substitute pressed carbon similar to that used in arc-lamp electrodes, as the latter can be more easily obtained in England.—*National Physical Laboratory, England.*

FURNACE, ELECTRIC.

Considerable success has been achieved in producing very perfect electrical oscillations and transformations of stored potential electrical energy into the form of heat by the application of a so-called power condenser, and an electric furnace has been constructed based on this principle.—*E. F. Northrup, Princeton University.*

HIGH-VOLTAGE TESTS.

Efficiency of high voltage transmission and the peculiarities of insulators for this kind of work. A new transformer will be installed to permit the production and use of higher voltages than those yet attempted.—*C. F. Harding, Purdue University.*

POWER IN ALTERNATING-CURRENT CIRCUITS.

Derivation of expressions for power and stored electrostatic and magnetic energy in a general network of conductors, with sources of alternating-current power connected thereto. The method of conjugate complex quantities is used.—*J. Slepian, Westinghouse Electric & Manufacturing Company.*

RECTIFERS, ALUMINUM.

For each of the four cells required in the ordinary arrangement for rectification of alternating current with lead-aluminum cells there was substituted a group of ten cells in series, and by this means a 2200-volt alternating current was rectified. With a considerable inductance in the circuit, the current curve was smoothed out so that it showed less than 20 per cent variation from its maximum value. When a constant voltage is desired but little or no current, a condenser across the terminals is used with good result.†—*N. H. Williams and J. M. Cork, University of Michigan.*

*The names of individuals given after each institution reporting investigations are those of persons with whom others interested should communicate. All institutions reporting research work should give such names.

APPARATUS AVAILABLE FOR RESEARCH

BALTIMORE, MD.

Facilities are available for testing high-tension cables for dielectric losses, temperature rise, heat dissipation, current-carrying capacity, etc. A special nine-hole conduit line has been constructed, surrounded by sand which is held in place by a wooden framework. The specimen cable occupies the central duct, while the outside ducts are taken by the "heater cables" for maintaining a desired temperature. A differential galvanometer-type thermometer is used, with numerous coils for measuring the temperature in the ducts. Three-phase 25-cycle current can be sent through the short-circuited specimen cable and high voltage applied at the same time, duplicating actual running conditions, or the high voltage may be applied to it on open circuit for measuring dielectric losses. For the results of some tests using this equipment see *Proceedings A. I. E. E.*, June, 1917, p. 449.—*Consolidated Gas, Electric Light & Power Company.*

HOUSTON, TEX.

Two synchronous machines are available for tests on sudden short-circuits: (1) Standard 45-kva., 500-volt, 60-cycle salient-pole alternator equipped with exploring coils at the top, middle and bottom of stator slots, and full-pitch and short-pitch coils on the rotor. (2) Special 5-kva., 220-volt, four-pole, 1800-r.p.m. non-salient pole alternator with characteristics approximating those of a turbo-alternator. The machine is equipped with several exploring coils in the stator and rotor having a span of a single tooth or a span equal to that of a pole. The rotor coils are brought out to an insulated fiber disk, and any one of them can be connected to a special pair of slip-rings for test purposes.—*N. S. Diamant, Rice Institute.*

SUGGESTIONS FOR RESEARCH

ALTERNATING CURRENTS.

A computing device which would add and multiply complex quantities or vectors. Such a device or machine would greatly save the labor in transmission-line computations and in the predetermination of performance of some types of electrical machinery.—*Editorial Suggestion.*

BATTERIES.

Some experiments seem to indicate that the electrolytic action in a lead battery is facilitated and made more complete in the presence of radio-active salts, for example radium barium sulphate. Further systematic experiments are desirable (see a recent French patent issued to Mr. Thofehern).

CABLES.

The problem is to dispose of heat due to copper and dielectric losses. This may be done in two ways—(1) by minimizing the amount produced, (2) by quickly conducting away the heat that is produced. The first is largely the problem of the cable manufacturer. The use of certain insulating materials in saturating paper insulation greatly reduces these losses. Cable ratings under some conditions may be more than doubled. We suggest that further investigations be made on the subject of dielectric loss in cables to the end that the laws governing it may be definitely known. It will then be possible for the manufacturer to give an even quality of cable with minimum dielectric loss. The second point is to conduct the heat away from cables after it has been generated. Most of the underground conduits now in use were built without any regard to their capacity to dissipate heat, and thereby immense sums of money have been thrown away. We further suggest that the use of 20,000-volt or 30,000-volt cables be investigated.—*A. I. E. E. Committee on Transmission and Distribution.*

CONDUCTORS, HARDNESS TESTS.

Development of a simple measure for detecting hard-drawn copper wire which is unsuitable for winding electrical coils. The method should be simple enough to be used in a factory without refined apparatus.—*C. E. Skinner, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.*

(1) A piece of steel wire might be pressed crosswise into the lateral surface of the copper wire under investigation. The magnitude of the impression left with a given force would be an indication of the degree of hardness. (2) There might be a difference of electric potential between soft copper wire and partially hard-drawn copper wire. The electrolyte used for this purpose should be acidulated copper sulphate. The difference of potential can be measured by a potentiometer. (3) One end of a piece of wire under test is clamped in a vise and the other end is provided with an iron tip. The wire is then made to vibrate under the action of an alternating-current electromagnet. The behavior of a soft wire will probably be different from that of a hard-drawn one. The vibrations can be made quite intense by adjusting the length of the sample to a natural frequency equal to or a multiple of that of the alternating current in the electromagnet.—*Editorial Suggestions.*

COPPER, TEMPERATURE COEFFICIENT.

Determination of the resistance coefficient of copper for a wide range of temperatures exceeding 200 deg. C.—*B. A. Behrend, Boston, Mass.*

CRANE.

In a traveling crane, a safety limit stop based on a dynamic brake action on the bridge travel motor, in conjunction with the ordinary type of rigid or spring bumpers. The museum will be pleased to receive expressions of opinion on the possibilities of such a device.—*American Museum of Safety, New York City.*

ELEVATORS.

Improvements in motors and control where only single-phase supply is available. This includes not only the use of single-phase motors, but also transformation to polyphase or to direct current.—*Editorial Suggestion.*

HYSTERESIS.

Rotatory hysteresis and the diminution of molecular losses at high densities.—*B. A. Behrend, Boston, Mass.*

†Reported in the *Michigan Technic*, December, 1917.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

If Your Paper Is Late

If your copy of the ELECTRICAL WORLD is late in reaching you, please wait a day or so before writing us that it has been lost. Unparalleled congestion of the mails has caused delays in delivery of all mail matter.

SWEEPING ORDER OF FUEL ADMINISTRATOR

To Solve Its Problem the Fuel Administration Orders Suspension of Industries for Five Days and Ten Mondays

The text of Dr. Garfield's order closing down industries to conserve fuel had not been completed at a late hour on Wednesday evening, Jan. 16. The Fuel Administration, however, issued a general statement on the order, and also an abstract of the essential provisions of the order.

"ALL INDUSTRY EQUALLY RESTRICTED."

The statement that was issued by the Fuel Administrator follows in part:

The unprecedented adverse weather conditions of recent weeks and the inadequacy of the present coal supply and transportation facilities to meet the enormous wartime demand have made necessary immediate restrictive measures as to the use of coal in that part of the United States east of the Mississippi River.

The movement of coal in transportation must be so directed as to aid the Director-General of Railways in dealing with the railroad emergency created by recent blizzard conditions. Domestic consumers of coal must be kept warm, and other absolutely necessary consumers must be supplied.

All industry must be equally restricted in its use of coal in order that the available supply for the remainder of the winter may be properly distributed and may be made sufficient for absolutely essential needs during the remainder of the winter.

To meet these necessities, the Fuel Administration has ordered as an immediate emergency measure that on the days of Jan. 18, 19, 20, 21 and 22 preference and priority in the use of coal shall be given only to those consumers whose consumption of coal is absolutely necessary.

During the five days designated no manufacturing industry shall be allowed to operate even if it has its coal supply on hand. By this means all industry will be placed on an equal footing and each will be called upon to make its share of the sacrifice necessary to maintain the nation at the highest possible point of military and economic efficiency for the prosecution of the war.

In addition to this emergency restriction over the designated five days, the Fuel Administration has ordered that all use of fuel except by consumers classed as absolutely necessary shall be prohibited on Monday of each week from Jan. 21 to March 25; that is, on Jan. 21 and 28, Feb. 4, 11, 18 and 25 and March 4, 11, 18 and 25.

The order under which these restrictions are made is designed to distribute with absolute impartiality the burden of patriotic denial. All classes of business are treated alike.

Except on the days covered in the order, the normal supply of coal to all consumers will be maintained. The necessary consumers designated in the order are given preference and priority in the delivery and use of coal at all times as well as on the days when other use of coal is prohibited.

The United States Fuel Administration counts upon the complete patriotic co-operation of every individual, firm and corporation affected by the order in its enforcement. Every effort will be made by the Fuel Administration and other government officials charged with the enforcement of the order to carry out the plan proposed without undue interference with the ordinary course of business.

It is the earnest desire of the Fuel Administration to prevent entirely any dislocation of industry or of labor.

ESSENTIAL PROVISIONS OF ORDER

The abstract of the order as issued in Washington follows:

(1) Until further order of the United States Fuel Administrator, all persons selling fuel in whatever capacity shall give preference to orders for necessary requirements

(a) Of railroads;

(b) Of domestic consumers, hospitals, charitable institutions and army and navy cantonments;

(c) Of public utilities, telephone and telegraph plants;

(d) Of ships and vessels for bunker purposes;

(e) Of the United States for strictly governmental purposes, not including orders from or for factories or plants working on contracts for the United States;

(f) Of municipal, county or state governments for necessary public uses;

(g) Of manufacturers of perishable food or of food for necessary immediate consumption.

The order further provides that on Jan. 18, 19, 20, 21 and 22, 1918, no fuel shall be delivered to any person, firm, association or corporation for any uses or requirements not included in the foregoing list until the requirements included in the list shall have been first delivered.

On Jan. 18, 19, 20, 21 and 22, 1918, and also on each and every Monday beginning Jan. 28, 1918, and continuing up to and including March 25, 1918, no manufacturing plant shall burn fuel or use power derived from fuel for any purpose except—

(a) Such plants as from their nature must be continuously operated seven days each week to avoid serious injury to the plant itself or its contents.

(b) Manufacturers of perishable foods.

(c) Manufacturers of food not perishable and not in immediate demand, who may burn fuel to such extent as is authorized by the Fuel Administrator of the state in which such plant is located or by his representative authorized therefor, upon application by the United States Food Administrator.

(d) Printers or publishers of daily papers may burn fuel as usual excepting on every Monday from Jan. 21 to March 25, 1918, inclusive, on which days they may burn fuel to such extent as is necessary to issue such editions as such papers customarily issue on important national legal holidays, and where such papers do not issue any editions on a holiday they are permitted to issue one edition on the said Mondays.

(e) Printing establishments may burn fuel on Jan. 18, 19, 20 and 22 to such extent as is necessary to issue current numbers of magazines and other publications periodically issued.

On each Monday, beginning Jan. 21, 1918, and continuing to and including Monday, March 25, 1918, no fuel shall be

burned (except to such extent as is essential to prevent injury to property from freezing) for the purpose of supplying heat for:

(a) Any business or professional offices, except offices used by the United States, state, county or municipal governments, transportation companies, or which are occupied by banks and trust companies or by physicians or dentists;

(b) Wholesale or retail stores, or any other stores, business houses or buildings whatever, except that for the purpose of selling food only, for which purposes stores may maintain necessary heat until 12 o'clock noon; and for the purpose of selling drugs and medical supplies only stores may maintain necessary heat throughout the day and evening;

(c) Theaters, moving-picture houses, bowling alleys, billiard rooms, private or public dance halls, or any other place of amusement.

On the above specified Mondays no fuel shall be burned for the purpose of heating rooms or buildings in which liquor is sold on those days.

No fuel shall be burned on any of the foregoing specified Mondays for the purpose of supplying power for the movement of surface, elevated, subway or suburban cars or trains in excess of the amount used on the Sundays previous thereto.

The order provides that nothing in this order shall be held to forbid the burning of fuel to heat rooms or such portions of buildings as are used in connection with the production or distribution of fuel.

The state fuel administrators are authorized by the order to issue orders on special applications for relief, where necessary, to prevent injury to health or destruction of or injury to property by fire or freezing.

The order is effective in all of the territory of the United States east of the Mississippi River, including the whole of the States of Louisiana and Minnesota.

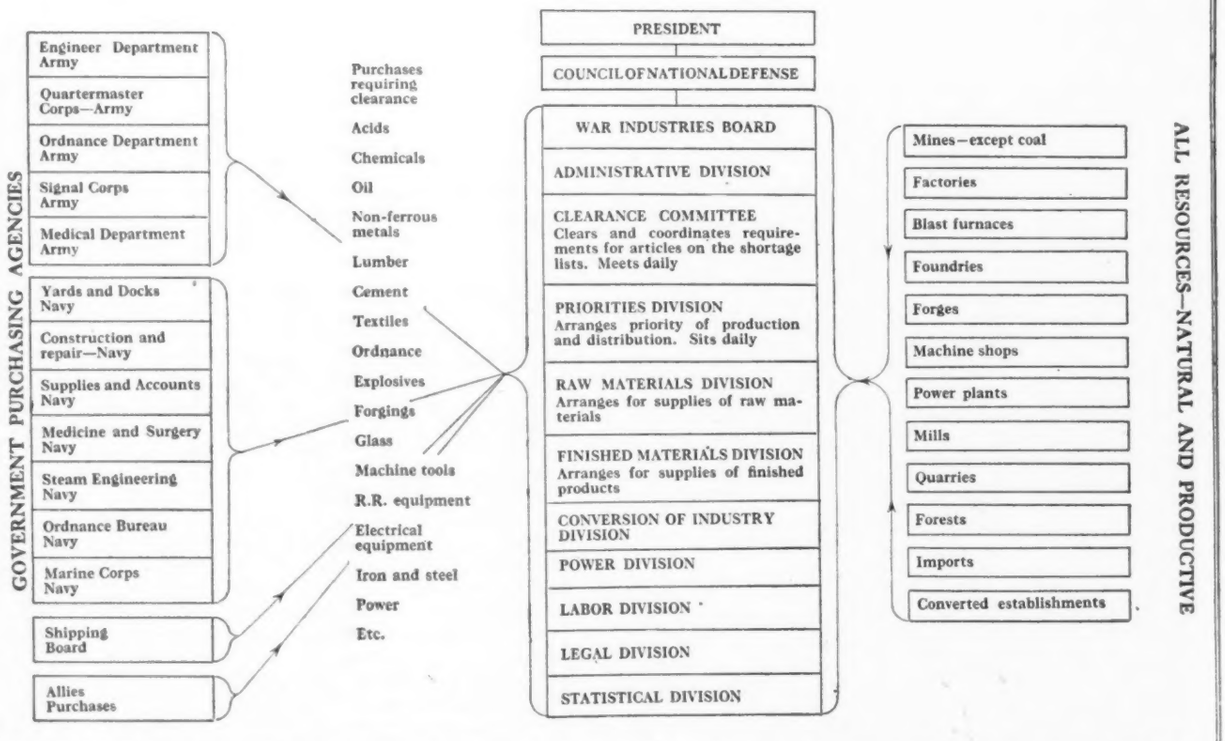
CHARLES L. EDGAR VIEWS EFFECT OF THE FUEL ORDER

Little Reduction in Lighting, but Considerable Reduction in Output to Industrial Plants Other Than Those Engaged on Government Work

Charles L. Edgar, president of the Edison Electric Illuminating Company of Boston, said that until he had seen the detailed order of the Fuel Administration he could make no accurate estimate of how much it will reduce the coal consumption at the Edison plant. He added:

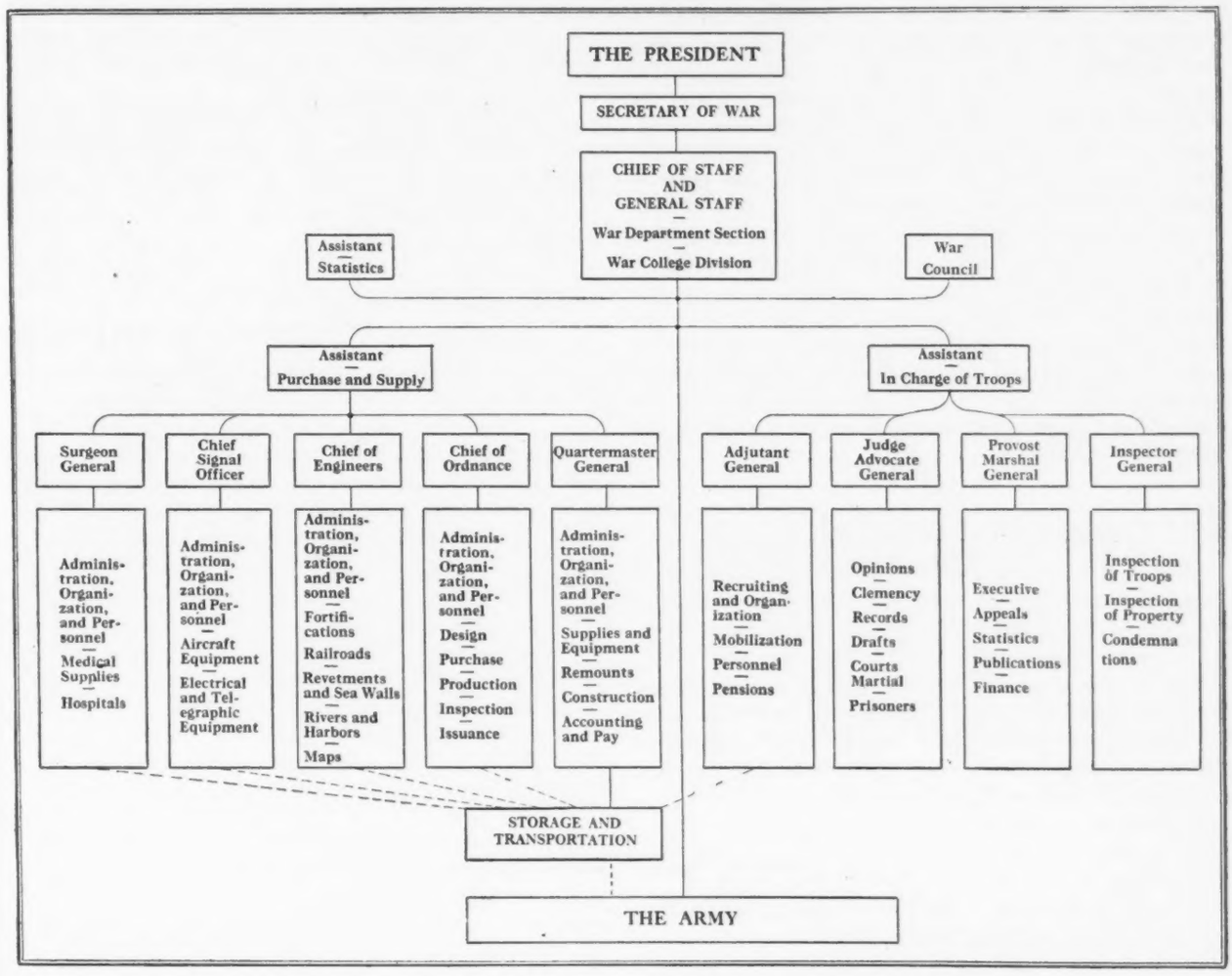
About one-half of our product is power and the other half light. There will probably be little reduction in the use of light. We have 1,000,000 customers who will use practically as much light, and the streets must be kept lighted. About one-third of the power we supply goes to government plants or factories making war supplies. From what I now know of the order there will be a considerable reduction of the two-thirds of our power output which goes to other industrial plants. We use about 5000 tons of coal a day. The recent "lightless" night order and other economies in the use of lights have reduced our daily coal consumption only from 30 to 40 tons a day. We have plenty of coal. I have not as full a knowledge of the coal situation as if we had ourselves been affected by the shortage. I did not suppose, however, that the situation was so serious as is indicated by the order just issued. This will bring great hardships to working people and their families, coming as it does in the middle of winter. I believe that the administration officials, realizing the hardships the order would bring, must have felt fully justified from the conditions in adopting such drastic measures.

ORGANIZATION AND FUNCTIONS OF WAR INDUSTRIES BOARD



NOTE: A "war industry" is construed to mean any industry which cannot meet the war-time needs without abnormal expansion or conversion of facilities

Washington, D C
January 9, 1918.


THE PRESIDENT
SECRETARY OF WAR
CHIEF OF STAFF AND GENERAL STAFF
War Department Section
War College Division
Assistant Statistics
War Council
Assistant Purchase and Supply
Assistant In Charge of Troops
Surgeon General
Chief Signal Officer
Chief of Engineers
Chief of Ordnance
Quartermaster General
Adjutant General
Judge Advocate General
Provost Marshal General
Inspector General
Administration, Organization, and Personnel — Medical Supplies — Hospitals
Administration, Organization, and Personnel — Aircraft Equipment — Electrical and Telegraphic Equipment
Administration, Organization, and Personnel — Fortifications — Railroads — Revetments and Sea Walls — Rivers and Harbors — Maps
Administration, Organization, and Personnel — Design — Purchase — Production — Inspection — Issuance
Administration, Organization, and Personnel — Supplies and Equipment — Remounts — Construction — Accounting and Pay
Recruiting and Organization — Mobilization — Personnel — Pensions
Opinions — Clemency — Records — Drafts — Courts Martial — Prisoners
Executive — Appeals — Statistics — Publications — Finance
Inspection of Troops — Inspection of Property — Condemnations
STORAGE AND TRANSPORTATION
THE ARMY

CO-ORDINATION PLAN FOR WAR PURCHASING

Outline of the New War Department Arrangements for Purchasing Supplies of Every Character for War Purposes Here

Secretary of War Baker explained in considerable detail to the Senate committee on military affairs on Jan. 12 the reason for his personal objection at this time to the creation of a Director of Munitions to supervise all purchases of supplies of every sort for war purposes in this country. These reasons may be summarized briefly by the statement that the reorganization of the War Department and the War Industries Board will provide an entirely suitable agency for promptly and efficiently performing such work and should be tried before the present organization, now in process of remodeling in the light of the experience of the administration in war work up to date, is thrown into inevitable confusion by drastic changes.

The War Department is not alone in making great drafts on the industries of the country. The Allies' Purchasing Board, the Navy Department and the Shipping Board are similarly straining the resources of our manufacturers and no legal remedy for this condition has been provided by Congress. But the four great purchasing agencies have agreed to joint action through the War Industries Board, which has been reorganized in order that it may do for all American munition manufacturers what the central bureau of the War Department does for its five great purchasing branches. The requirements of the four agencies are reported to a central committee, which is directly in touch with the manufacturing facilities of the country and not only knows how much work each factory is doing for the government but also how much it is doing for necessary civilian customers. It is this committee which passes on the priority to be given each of the orders. If its decisions are questioned, the appeal is made to the War Industries Board, which thus becomes arbiter of manufacturing priority in this country in every industry furnishing supplies for military uses.

Secretary Baker assured the Senate committee on military affairs that this system of handling the government war purchases in co-operation with those of the Allies was not only the best that careful study had been able to suggest but had met with the approval of the industrial leaders to which it had been submitted. It disorganized none of the existing machinery and interfered as little as possible with meeting civilian demands, in his opinion. It was the equivalent, he believed, of a special director of munitions, for any functions which such a director would possess would be possessed by Daniel Willard, chairman and executive officer of the War Industries Board. The chairman did not have legal authority to enforce his decisions, but as each of the four great war purchasing agencies had agreed to recognize his decisions as binding, it had not seemed necessary to ask congressional action to confer legal powers upon him.

The essence of the organization, according to Secre-

tary Baker, is that each of the four great purchasers—the Allies' committee, the War and Navy Departments and the Shipping Board—has its own organization for acquiring its supplies in the desired order. While the War Industries Board has these orders filled in the sequence of the war needs, manufacturing facilities and civilian requirements are served in the best possible manner. It is apparently the administration's answer to the criticism that Washington had no logical plan for mobilizing the nation's resources. According to Secretary Baker, it is the most complete plan for the purpose that has been advanced in this country or Great Britain. It manifestly created a deep impression upon members of the Senate committee, who have indicated their disapproval of many features of the work of the War Department since the United States entered upon the war.

WESTINGHOUSE COMPANY ISSUES $15,000,000 NOTES

One-Year Securities Put Out Without Objection of Federal Reserve Board—Unfilled Orders Jan. 1, Excluding Rifles, $130,000,000

The Westinghouse Electric & Manufacturing Company has sold $15,000,000 of one-year 6 per cent notes to Kuhn, Loeb & Co., New York. The notes were offered by the bankers to the public at 99 and interest, yielding a little over 7 per cent net.

A letter to the bankers from Guy E. Tripp as chairman of the Westinghouse company gives the following information regarding the purpose of the issue:

In order to assure to itself for a fixed period working capital temporarily required to carry the large inventories which it is essential that the company should have under present conditions, the Westinghouse Electric & Manufacturing Company has decided to create an issue of 6 per cent one-year gold notes, limited to $15,000,000. This company has advised the Federal Reserve Board of its intention to issue these notes, and the board has stated that it has no objection to the issue being made.

The indenture under which the notes are to be issued will provide that the company (including its proprietary companies as defined in said indenture) shall at all times while the notes are outstanding have on hand current assets, as defined in said indenture. equal to at least twice the amount of its current obligations, as also therein defined, and that it will not hereafter and so long as any of the notes are outstanding make or permit to be made any mortgage on any of its properties or the properties of any of its said proprietary companies.

The new notes will be issued in denominations of $1,000 each, will be in coupon bearer form and will mature on Feb. 1, 1919. Interest at the rate of 6 per cent per annum will be payable semi-annually on Aug. 1, 1918, and Feb. 1, 1919. Both principal and interest of the notes will be payable without deduction for any tax or taxes which the company or the trustee under the indenture may be required to pay or to retain therefrom under any present or future law of the United States of America (except any federal income tax) or of any state, county, municipality or other taxing authority therein.

As of Jan. 1, 1918, the company had on hand unfilled orders amounting to more than $130,000,000, exclusive of contracts for rifles. As of Dec. 1, 1917, its current assets as they will be defined in the indenture amounted to over $71,000,000, while its current liabilities as so defined amounted to less than $24,000,000. which the present issue of notes will not increase. as the proceeds thereof will be applied to the payment of outstanding notes. The funded debt of the company, consisting almost entirely of the Westinghouse Machine Company first and refunding mortgage bonds, due 1940, amounts to about $6,700,000, and its capital stock, now paying 7 per cent dividends per annum, amounts to $74,812,650 and has a present market value of over $60,000,000.

The earnings of the company for the eight months ended Nov. 30, 1917, after deduction of all interest charges and after setting aside a maximum reserve for all income and excess profits taxes, amounted to $9,032,823, which is only $582,101 less than for the same period of the previous fiscal year, when there were no war income or excess profits taxes deductible.

WAR SERVICE WORK OF MANUFACTURERS' COMMITTEES

Meeting of Chairmen of Group Committees of Manufacturers of Electrical Supplies Emphasizes Desire to Organize the Whole Industry

A meeting of chairmen of the war service group committees of manufacturers of electrical supplies was held on Jan. 11 at the rooms of the Associated Manufacturers of Electrical Supplies, New York. It was called to hear reports from the chairmen of the committees and to further the co-ordination of their war service work for the government. Robert K. Sheppard, chairman of the General War Service Committee of the Electrical Manufacturing Industry, presided.

It was made plain at the meeting that, as stated previously in the ELECTRICAL WORLD, the whole purpose of the movement is to effect complete organization of every branch of the industry in the interest of service to the government. To this end the chairmen of the committees are corresponding with and obtaining reports from manufacturers without regard to the question of whether they are or are not members of the association. The committees are termed "group" committees and in every instance regard themselves as serving to centralize the activities of all of the productive capacity of groups within the industry in order that this entire capacity may be made available to the government without loss of time or effort on the part of the federal authorities.

GRAVE POWER SHORTAGE IN NEW JERSEY PLANTS

Public Service Electric Company, on a "Hand-to-Mouth" Basis of Coal Supply, Has to Cut Service Radically

As a result of coal shortage the Public Service Electric Company, Newark, N. J., is able to operate generating stations at only about 50 per cent of capacity. It is on a "hand-to-mouth" basis of coal supply. Facing absolute shortage of energy to meet requirements of its power customers, the company created a zone system under which partial service is given.

Power customers receive service from 7 a. m. to 4 p. m. on Monday, Wednesday and Friday in the Essex and Bergen divisions and on Tuesday, Thursday and Saturday in the Hudson, Passaic and Central divisions. The Southern division, in the district around Camden, is not affected now by these restrictions. In the other divisions named the company tries to meet the normal requirements of power customers in accordance with the schedule of days indicated.

The company has also reduced the quantity of street lighting in the various communities served.

War's Effect on Cost and Quality of Service

Paper of Lynn S. Goodman and William B. Jackson, Presented Before American Institute of Electrical Engineers—Average Coal Cost Increase 100 per Cent—Discussion in Boston and New York

A PAPER by Lynn S. Goodman and William B. Jackson on "Effects of War Conditions on Cost and Quality of Electric Service" was presented at an intersectional meeting of the American Institute of Electrical Engineers in Boston on Jan. 8, in New York on Jan. 11, and in Chicago on Jan. 14. The paper was presented under the auspices of the committee on the economics of electric service.

The employment of women has enabled electric utilities to obtain an additional class of labor at a relatively low rate, but when women take the places of men more women employees are required than the number of men replaced, and the war conditions tend to exhaust the supply of even this class of labor by offering wider fields of employment. The necessity for female labor to become more nearly self-supporting during war times further tends to increase the female wage scale.

It is recognized that the labor cost to public utilities will further advance either by increases in the direct wage or by some system of war additions such as are being employed by the other nations at war. This system of war additions is generally recognized as a measure to compensate for the temporary increases in living costs during the war period and is adopted principally in order to facilitate the ultimate return to normal conditions. By normal conditions is meant the conditions which would have been attained normally had war conditions not intervened.

From 1902 to 1912 the average wages per employee (exclusive of general officers, managers and superintendents), according to United States Census statistics, increased 11 per cent. During the war period thus far salaries of officers, managers and general superintendents in general have not increased greatly, but increases in wages in operating departments have ranged from 15 to 50 per cent, and Messrs. Goodman and Jackson are of the opinion that 25 per cent may be taken as the average increase thus far occasioned by the war. The increase in wages of 25 per cent means an estimated outlay of $19,000,000 for the year.

The draft on men for government service and the war scale wages in industrial fields mean cost for training new operatives, and the continual change has also an effect on economy of operation and quality of service.

On the average, the authors conclude, the cost per ton of coal to electric companies has increased a little more than 100 per cent on account of war conditions. A conservative figure for the increase in tonnage due to lower quality and non-uniformity of grade is 10 per cent, making a total increase of $60,000,000 on top of the estimated expenditure of $50,000,000 had normal conditions prevailed in 1917.

It is estimated by Messrs. Goodman and Jackson that the increase in cost of materials and supplies other than fuel is 75 per cent, or $30,000,000. In many cases the necessity or advisability of retaining present equipment in service until change is imperative introduces an element of reduced economy.

Protection of plants adds to cost of service an estimated $2,000,000 or $3,000,000. Normal taxes might have been $25,000,000, but it is guessed that the increase above this will be, say, $7,500,000.

The total of $116,500,000 thus indicated is a quarter of the normal estimated gross revenue for 1917. It wipes out two-thirds of the sum that would have been available for interest, dividends and surplus. Messrs. Goodman and Jackson conclude that it puts the electric companies in a critical position.

Reviewing other considerations, the authors say that the advantages of the central station are so large that it is advisable for the government to use every reasonable means to encourage the central-station companies and discourage individual power plants during the war period.

One phase is improvement in load factors arising from putting less essential industries on an off-peak basis and the fact that war industries give an exceptionally long home demand.

Coal clauses, adopted by many companies, are regarded as only a partial remedy as the increase in cost for coal is only about one-half of the total increase in cost due to war conditions. Extension of the central station into the field served by isolated plants and especially the acceptance of temporary or auxiliary loads carries the menace that the central utility will be burdened with unused and abnormally expensive station capacity at the end of the war period.

Discussion at the New York A. I. E. E. Meeting

In opening the discussion E. W. Rice said that while the Goodman and Jackson paper paints a somber picture it presents a definite problem to engineers. With a problem well stated the solution is half found.

The grave fact that the New York Central Railroad came within three hours of having to suspend service for lack of coal should bring home to every one the necessity of conserving fuel, said Colonel Arnold. Every central-station company is doing what it can in this direction. Additional help can be afforded by electric service companies, through the consent of public utility commissions, by curtailing the amount of energy supplied to other than essential industries and by serving munition plants and other industries necessary to the conduct of the war to the maximum of their facilities. Industries which would suffer seriously by having their energy supply curtailed could be served during off-peak periods. By classifying different loads central stations could so group and serve these industries that their demands would overlap to better advantage and give better load factors. Thus the maximum use of equipment could be secured.

Pooling of generating and transmission facilities would also greatly relieve present difficulties, it was pointed out, as loads could be carried on the most economical generating equipment, less reserve capacity would be required, and advantage could be taken of

diversity factors, thus reducing peak loads, etc. Where exhaust steam can be used throughout the year there is an advantage in isolated-plant service. Otherwise it is generally cheaper to buy central-station power.

VALUE OF WATER-POWER DEVELOPMENT

Philip Torchio pointed out that it is inequitable for public utilities to be required to furnish service at the same rates as in normal times when other industries are allowed to increase prices to cover increased expenses. Referring to the shortage of coal and the necessity of conservation, he stated that if all of the water power east of the Rocky Mountains (*i.e.*, one-third of the total) were developed, 50 per cent of the coal used for primary power could be replaced. However, even after all water power is developed there will still be need of coal for generating purposes; therefore steam stations will be a permanent factor in the national development. If all stations in the country could be brought to the stage of development which some of the modern ones have reached, four times as much energy could be developed per pound of coal. In other words, a considerable saving could be realized by carrying loads of the inefficient plants in modern systems. Referring to the effect of war conditions on cost of operating electric utilities, Mr. Torchio said that in New York the total cost has increased 50 per cent, while the operating cost has increased 95 per cent. In concluding his remarks, he read a forecast he made ten years ago regarding the necessity and advantages of a nation-wide network of electric service lines.

HANDICAPS UNDER WHICH CENTRAL STATIONS LABOR

Major Betts referred to steps taken by the New York companies several years ago to obtain emergency service from each other. The wisdom of such arrangements in every locality was demonstrated lately in New Jersey, where several water companies had to depend on one company for supplying service.

Referring to the handicaps under which central stations have to meet increased demands for energy, Major Betts pointed out that the cost of labor has increased phenomenally, that help is uncertain and of a shifting nature, and that coal deliveries are slow if forthcoming at all. Owing to the latter cause and the inability to get additional generating equipment, the New Jersey company has had to cut off 40 per cent of its power load, causing cessation of many necessary industries and throwing many employees out of work.

The vital problem is to keep industries going, not only because the products of many are essential, but because employment depends on operation of factories. The uses for coal should therefore be classified and preference given to those which have essential products and a large number of employees. In justification of this priority list, Major Betts pointed out that there is just as much reason why power supplied to certain industries should be curtailed as there was that the draft law be put into effect. In view of this necessity central stations should take steps to acquaint present and prospective consumers with uses of energy which inure to the nation's interests.

W. S. Dorcess spoke of the effect of present conditions on the cost of power, calling attention to the inefficiency and changing nature of labor, its higher cost, the necessity of having to shorten working periods, the higher prices of materials and supplies, including fuel, and larger losses due to use of lower-grade fuels. He estimated that the average price of all labor in central-station service has increased 30 per cent, that repair materials have increased as much as 90 per cent, and that the average price of fuel has increased 65 to 70 per cent (over 100 per cent in some cases).

H. M. Hobart said that while it was formerly impossible to secure some large loads unless the price of energy was brought lower, the war has forced them to apply for central-station service. Furthermore, war conditions have made all plants operate more economically and with least reserve equipment.

RELATION OF CENTRAL STATION TO WAR PROGRAM

Prof. D. C. Jackson said that the success of the war depends on the rate of industrial production rather than on any particular implement of warfare. For this reason the central station is eminently important, as it furnishes the quickest means of speeding up production. National authority should take this into account, he said. Labor shortage in the electric service field is due to distribution of labor rather than to actual shortage of men. The solution to this difficulty is to adapt the labor of which there is a surplus to the trades in which there is a scarcity of help.

In the absence of Mr. Bartlett, who presented a written discussion, Mr. Jackson read the paper, which contained observations on turn-over of labor. Statistics showed that in one case this was as great as 211 per cent. The reasons attributed for this were varying remuneration, men enlisting for military service, difficulty of filling positions, and unsettled labor conditions. Competition in securing labor was emphatically discouraged. Reference was made to one executive who said he could operate with women except in positions requiring manual labor. To hold men it was urged that the department heads get closer to the hearts of their men.

PRESENT COSTS AND RATES

F. A. Bryan brought out that, owing to the high cost of fuel, customers who formerly used isolated plant power have demanded central-station power. This means that the steam plant that had been held purely as reserve for his hydroelectric plant has had to be brought into regular service, thus requiring fuel at the present very high cost and materially increasing operating expenses and necessitating early additions and extensions. The question was raised whether the managers of electric properties are justified in taking on such additional business in the light of the very high cost of plant equipment and extensions and the high price of labor, fuel and supplies, unless they can have some assurance that these conditions will be taken into consideration by regulatory bodies both as they affect the present costs and as they affect them for the period succeeding the war.

F. G. Hudson stated that the regulatory bodies should appreciate the necessity of higher rates in the conditions under which utility corporations have to operate. In view of the increasing operating cost, it would be precarious and unwise to ignore the necessity for effectively working out the serious problems now presented. Certain partial solutions were suggested. Mr. Hudson also advocated the consideration by proper authorities of arranging some plan whereby skilled

workmen may be retained in positions for which they are best fitted, to the end that satisfactory service may be maintained.

Mortimer Freund said that while the central station is of prime importance, especially now, the individual power plant should not be discouraged so long as every effort is made to fulfill heat, light and power requirements with the least possible fuel waste. He discussed several situations where he considers the private power plant can supply electric service economically, and suggested the possibility of co-operation between private plants and central stations in supplying energy.

Discussion at the Boston A. I. E. E. Meeting

N. J. Neall, Boston, consulting electrical engineer in the building of the Ayer (Mass.) cantonment, said that the price per kilowatt-hour had not been increased materially to the public. He doubted whether the utility financial return situation was so serious as the authors contended. The remedy lay in rate increases. Net loss of revenue applicable to dividends could not be appraised fully until the effect of increased power rates was seen. Unless ordinary demands for service were financed as the need was met, the utility would hardly be in the position of being under obligation to meet such demands.

Mr. Neall suggested pooling coal distribution by utilities. Possible gains in economy of utility service lie along such lines as more economical use of coal, burning poorer grades of coal, substitution of other metals for present standard material, use of booster transformers in place of copper on certain distribution circuits, location of plants at mines and development of water power, with consolidation and interconnection of systems. Cultivation of off peak loads is important, and non-essential industries might help by running nights and staying off the peak.

Prof. C. A. Adams, Harvard University, emphasized the efficiency decrease in plant operation due to coal high in ash. Ten per cent, he held, was a great underestimate of the decrease in economy in central stations resulting from poor fuel. Twenty per cent ash occurred in some cases. This meant larger stand-by losses, since more boilers must be held on the line than with good coal. Slate and stone in coal might increase consumption 30 per cent. The number of boilers for a given load might increase by 40 per cent in some cases.

GREAT IMPORTANCE OF CONTINUOUS SERVICE

Joseph Sachs, Westinghouse Electric & Manufacturing Company, Pittsburgh, cited the great importance of continuous service in munition plants. Some action should be taken by the government or others so that maintenance needs of central stations would not be overlooked by manufacturers. Where electrical material is being pushed into the background because plants are producing munitions on a large scale, there is danger that breakdowns may be protracted by shortage of needed supplies. This situation obtains in Germany. Night work by non-essential plants is now being practiced in Pittsburgh. The speaker thought the chances of increasing central-station efficiency poor at present.

The present problem is one of production without regard for money making, stated D. B. Galusha of Stone & Webster, Boston. If private capital cannot furnish sufficient power, the government would have to do so. Mr. Galusha said that powdered fuel was being used successfully in one of the Western central stations of Stone & Webster where fuel oil could not be obtained on a satisfactory basis, or coal of a grade which could be burned on chain-grate stokers.

J. F. Vaughan, consulting engineer, Boston, pointed out the small percentage increase 1 mill represents on a 10-cent lighting rate as compared with a similar net advance in power charges.

B. A. Behrend, consulting engineer, Boston, objected strenuously to the policy, advocated in some quarters, of having central stations give poorer service.

Prof. D. C. Jackson, Massachusetts Institute of Technology, Cambridge, urged larger use of the central station on account of the reduced number of men required for a given output for installation, operation and supervision. The men at the front would be absolutely serviceless unless backed up by manufacturers having ample power supply. The speaker touched briefly upon the desirability of utilizing men trained in one trade in another trade in the off-season, such as converting bricklayers into sheet-metal workers during the winter. A prominent union official also favored this idea, Professor Jackson said.

AN "INDUSTRIAL LEGION"

The need of a sane return to investors, of an increased number of off-peak customers, and the tendency of the isolated plant to reach a more critical position, were emphasized by Prof. R. G. Hudson, Massachusetts Institute of Technology, who also stated his belief in the establishment of an "industrial legion" with appropriate insignia for those helping the country's war work at their posts in power plants, etc.

A written discussion submitted by W. S. Gorsuch, New York, analyzed the effect of increased wages, reduced working hours, inefficient labor and increased coal cost upon unit generating expenses. In many cases, he held, inefficient labor was paid more now than better men received before the war. The cost of a large portion of power-plant labor had increased from 30 to 55 per cent. Present increased wages were liable to remain after the war, but doubtless more efficient labor will be available. Repair parts in some cases are 90 per cent more costly than previously, discouraging maintenance work. With detailed figures, the writer showed that if any corrections or increases are made in rates to cover increased cost of coal, they should be made on the basis of B.t.u. per dollar and not on the increased cost of fuel per ton.

Mr. Gorsuch stated that the recent rise in labor and material costs had increased operating expenses at a rate much faster than any possible economy resulting from increased load factor. The question whether it was worth while for some small companies to generate their own energy or purchase it from an ample source was purely an economic one, he said. To illustrate this, consider two plants, one having a maximum load of 40,000 kw. and a 45 per cent load factor and the other a maximum load of 10,000 kw. and a 25 per cent load factor, with non-simultaneous peaks. In a typical case the load curve of the smaller plant was superimposed on that of the larger, with a resulting diversity in power-station demands of 5000 kw. and a reduction in the cost of generation.

Nation Needs Men for Searchlight Regiment

The Fifty-sixth United States Engineers, Now Being Organized, Offers Opportunity for Young Men with Electrical Experience or Fundamental Knowledge of Electricity and Mechanics for Special Service Abroad

AN EXCELLENT opportunity is being offered to young men possessing a knowledge of electricity and mechanics, as well as to experienced electricians, gas-engine operators and machinists, to serve the government effectively in its fight for democracy. The War Department is organizing a regiment of searchlight companies for special service abroad. These units will be highly specialized and used for battle illumination and anti-aircraft protection. The companies will be armed and equipped as regular military units and will form part of the regular army organization. They will be called upon for extremely active work in the war zone, and pains are being taken in the selection of the personnel of the companies.

In special cases men of proper experience who already have been drafted into service may be transferred. In order to obtain those of suitable qualifications, a special ruling will permit men within the draft age but not yet called to be inducted directly into this regiment. The plan is to obtain bright, young, intelligent and ambitious men who possess a fundamental knowledge of electricity and mechanics, as well as trained and experienced electricians, gas engine operators and machinists. The enlisted personnel will embrace men experienced in one or more of the following occupations: Electricians, gas-engine operators, machinists, motor-truck drivers, blacksmiths, horseshoers, mechanics and general all-around utility men.

Men must first enlist as privates and will be paid $30 per month, together with food, clothing, medical attention, etc. Non-commissioned grades will be available at rates of pay from $36 to $96 per month, and future promotion is open to those of ability.

Specialized service of this character offers unusual opportunities for those capable of performing it. The character of the work will be highly interesting and varied. The man who has the necessary training and ability cannot serve his country better than by joining such an organization.

The war as it is now being fought offers great opportunities for the use of searchlights for defensive as well as for offensive operations. Among the uses of projectors on the battlefield are the following:

To discover and keep in touch with the movements of the enemy during the night.

To seek out and illuminate hostile objectives, so as to fire upon them.

To blind the enemy.

To illuminate roads and possible hostile positions in the more distant foreground periodically by the light.

To search the near foreground.

To support fire effect by illumination of hostile targets.

To disturb hostile works by alternate blinding and turning on the beam or by working the beam back and forth.

To blind opposing searchlights.

To support attacks in the foreground by throwing the beam in front of the advancing troops and screening their movements.

To reveal obstacles to their own artillery, which is thus enabled to destroy the obstacles.

To blind the enemy and disturb his forward march and firing capacity and confuse him by making him think his plans are discovered.

To facilitate the landing of aviators at night.

For anti-aircraft work and night-bombing defense.

The foregoing summarize the general activities of this new regiment. Information may be obtained by writing directly to the commanding officer, Fifty-sixth United States Engineers, Washington Barracks, D. C. The applicant must give the following information: (1) Name, (2) address, (3) age, (4) married or single, (5) nationality, (6) whether he will enlist for the period of the war, (7) brief statement of education, (8) present occupation, (9) experience, (10) name and address of present or former employer, (11) whether or not the applicant has been drafted.

Cleveland Rate Case.—F. W. Ballard, employed by the city of Cleveland as expert in its contest before the Ohio Public Utilities Commission with the Cleveland Electric Illuminating Company, has written a review of the case which is to be published in a magazine in February. Copies of the review, however, have been sent to Governor Cox, the utilities commission and the Cleveland Engineering Society. Mr. Ballard is preparing an argument against the valuation to be presented to the commission. The order as to the valuation has been appealed to the Ohio Supreme Court. Unless this court should nullify the order, the rate will be based upon this valuation and the city ordinance would thus be rendered void.

Teutonic Electrical Troubles.—That conditions in the German and Austrian electrical industries are not so rosy as censored dispatches seem to indicate is shown in occasional quotations from financial reports to stockholders of electrical concerns. The following is from a report issued to stockholders by directors of the Austrian Siemens-Schuckert Works: "It is true that these works are operated at full capacity, but nearly all of the work is done for the War Department, which precludes the charging of profitable prices for our products. It must also be remembered that while wages, materials and overhead expenses are rising continually, the productive capacity of such employees as we can retain is gradually sinking lower and lower. Under these conditions profits or dividends are unlikely."

Postponement of "Anti-Trust" Cases.—In petitioning the United States Supreme Court to postpone the hearing of the "anti-trust" cases until the next term, Attorney General Gregory gave the following reasons for his request: "In order that the government in this time of stress may not meet with competition from private enterprises in its financial operations and the flotation of its loans, the Treasury Department has been constrained to urge that all private financing on a large scale shall be avoided so far as at all possible. Thus, in his annual report on the finances for the fiscal year ended June 30, 1917, the Secretary of the Treasury makes the following observation: 'The government must, if necessary, absorb the supply of new capital available for investment in the United States during the period of the war. This, in turn, makes it essential that unnecessary capital expenditures should be avoided in public and private enterprises.' It is quite clear that the dissolutions which are sought in the pending cases against the United Shoe Machinery Company, International Harvester Company, United States Steel Corporation, Eastman Kodak Company, American Can Company, Quaker Oats Company and Corn Products Refining Company will require financial operations on a large scale if they are to be genuine and effective. Important as the remedy sought in these cases is believed to be, it must give place for the moment to the paramount needs of the hour."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electric Shop Discontinued.—The Commonwealth Edison Company original electric shop, Jackson and Michigan Boulevards, Chicago, which was operated for nine years from January, 1909, was discontinued on Jan. 1, 1918. George B. Johnson, manager of the shop, has been transferred to the contract department. This electric shop was one of the best known in the country and has been visited by many thousands of persons in the electrical industry interested in modern ideas on electrical merchandising.

Chicago Sanitary District Seeks Plan to Get More Water from Lake Michigan.—The Sanitary District of Chicago has passed an ordinance tendering $475,000 to the United States. In return the Sanitary District expects to get an unqualified permit, by act of Congress, for the immediate use of 520,000 cu. ft. of water a minute from Lake Michigan, with provision that additional water may be withdrawn, up to 720,000 cu. ft., as the population of Chicago increases. The latter figure is the maximum that can be handled by the channel and works as at present constructed. If the federal government accepts this offer, it is expected that the $475,000 will be expended by it in building compensating works in the St. Clair and Niagara Rivers to preserve water levels which it is said would be lowered if the Sanitary District were permitted to take the additional flowage. The proposed compromise is based on the report of federal engineers, of whom Gen. William M. Black, now chief of engineers in the United States Army, was the senior. This report was made on account of a federal lawsuit intended to limit the Sanitary District to the use of 250,000 cu. ft. of water.

The J. E. Aldred Lectures.—Through the generosity of J. E. Aldred there has been founded in the department of engineering of Johns Hopkins University, Baltimore, a course of lectures on engineering practice. The course of lectures is one feature of a general plan, made possible by Mr. Aldred's gift, for furthering and improving undergraduate instruction in the methods and problems of the practice of engineering. The lectures will deal, therefore, with the practical phases of engineering problems rather than with theory. They are not expected to discuss new and striking applications as much as to deal with every-day working methods of design, construction and operation. During the year three lectures each will be given upon the general subjects of civil, electrical and mechanical engineering. They will be given on Wednesday evenings at 8 o'clock in the auditorium of the Civil Engineering Building of the university at Homewood. The lectures are open to the general public. A partial list of the lectures follows: Jan. 16, "Steam-Electric Power Plant Design," A. S. Loizeaux, electrical engineer Consolidated Gas, Electric Light & Power Company, Baltimore; Jan. 30, "The Relation Between Civil Engineering and Military Engineering," Major-General William M. Black, chief of engineers, U. S. A., Washington; March 6, "The Growth of Electric Systems," Julian C. Smith, vice-president Shawinigan Water & Power Company, Montreal, Canada; March 13, "Coal and Its Combustion in Boiler Furnaces," E. G. Bailey, president Bailey Meter Company, Boston.

Underwater Section of Halifax Power Cable Survives Explosion.—In the explosion at Halifax, N. S., on Dec. 6 service was interrupted on a 13,200-volt transmission circuit by which the Nova Scotia Tramways & Power Company supplied energy to the suburb of Dartmouth, on the east side of Halifax Harbor. The overhead section of this line was illustrated in the ELECTRICAL WORLD of Dec. 15, 1917, page 1162. Since the visit of the representative of this journal to Halifax it has been learned from H. R. Mallison, managing director of the company, that the submerged portion of this circuit sustained no damage. The underwater section consists of 2800 ft. of three-conductor, No. 4 R. & S. stranded rubber tape and varnished-cambric insulation, jute fillers, varnished-cambric belt, lead sheath, jute bedding and No. 4 B. W. G. wire armor, designed for 15,000 volts working pressure. This portion of the cable was laid in two sections, the joint being approximately in the middle of the harbor and well within the explosion zone. The shore-end sections consist of about 600 ft. of three-conductor No. 2 B. & S. gage, stranded, of the same general construction as the submarine section. These shore sections are joined to the submarine section at approximately the shore line and continue underground to the terminal pole, where they are connected with the aerial lines. The explosion damaged the pot-heads on the shore poles on each side of the harbor and they had to be replaced. In underrunning the submarine cable for inspection a 5-ton anchor was discovered firmly fixed to the cable; but the anchor had been there prior to the explosion and apparently caused no damage to the cable at the point of contact, although it is apparent that the anchor lifted the cable to the surface before it was cut away and drew the cable very tight from the east shore of the harbor. In grappling for the cable a large amount of wreckage was found, including piles, timbers and fragments of iron presumably blown into the water from the ship Mont Blanc. The cable was found completely covered with a tar-like substance such as smeared survivors from the explosion who were in the vicinity. Temporary service to Dartmouth pending repairs to the transmission line and pot-heads has been supplied from the plant of the Woodside sugar refinery.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Max Thelen was re-elected president of the Railroad Commission of California at the annual meeting of the commission on Jan. 2. This will be President Thelen's fourth term as head of the commission.

O. S. Yager has resigned his position as assistant to general manager of the Logan County Light & Power Company, Logan, W. Va., to become municipal superintendent of the city of Eaton Rapids, Mich.

P. M. Richards, formerly superintendent of the city light and water plant of Metropolis, Ill., is now associated with the Chuse Engine & Manufacturing Company at Mattoon, Ill., in the capacity of erector on outside work.

J. H. Kracke, formerly commissioner of plants and structures in the city government, has succeeded Col. William Hayward, now in military service, as a member of the Public Service Commission for the First District of New York.

A. D. Johnson, formerly Cambria representative for the Wisconsin Power, Light & Heat Company, has been appointed division superintendent for the company, with headquarters at Portage, Wis., succeeding F. M. Nourse, who has accepted a position in Chicago.

J. H. DuFresne has resigned as auditor and assistant treasurer of the Choctaw Power & Light Company, McAlester, Okla., to become auditor of the Minneapolis General Electric Company, Minneapolis, Minn. Mr. DuFresne was also chairman of the auditing and accounting committee of the Gas, Electric and Street Railway Association of Oklahoma.

Capt. Edwin W. Moore, chief senior aide to Major-General John F. O'Ryan, commanding the Twenty-seventh Division, U. S. A., besides being president of the Bare Wire Company, as stated in the Jan. 5 issue of the ELECTRICAL WORLD, is president of the Habirshaw Electric Cable Company of Yonkers and the Electric Cable Company of Bridgeport.

Van Dusen Rickert, who early in October resigned as assistant general manager and assistant secretary and treasurer of the Eastern Pennsylvania Railways Company and assistant general manager and secretary and treasurer of the Eastern Pennsylvania Light, Heat & Power Company, to take effect when a new general manager was appointed, severed his connection with these companies Dec. 31.

James E. Davidson, vice-president and general manager of the Nebraska Power Company of Omaha, Neb., is the new president of the Nebraska Section, N. E. L. A. Mr. Davidson was formerly with the public utility companies at Port Huron, Mich., and served as secretary-treasurer of the Michigan Electric Association. Later he became president and manager of the Consolidated Lighting Company of Montpelier, Vt. He was president of the Vermont Electrical Association in 1909 and president of the New England Section of the National Electric Light Association in 1910-1911.

W. D. Clark has succeeded R. S. Dunning as secretary of the Cleveland Electric Club, Jovian Chapter.

E. H. Merrill has been appointed chief engineer of the Galesburg (Ill.) Railway, Lighting & Power Company to succeed L. N. Jenkins.

L. N. Jenkins has resigned as chief engineer of the Galesburg (Ill.) Railway, Lighting & Power Company, to take a position in Omaha, Neb.

Michael Condon, Orange, N. J., has been named engineer for the municipal power plant, Orange, by the City Commission, to succeed James McElroy, deceased.

Guy E. Tripp, heretofore chairman of the Westinghouse Electric & Manufacturing Company, has been appointed head of the division of production in

G. E. TRIPP

the ordnance department of the United States Army. He has already entered upon his duties, and the board of directors of the Westinghouse company has given him a leave of absence for the duration of the war.

E. A. Baily, secretary to the vice-president of the Edison Electric Illuminating Company of Brooklyn, is now in Washington, D. C., for an indefinite period, where he is associated with the section on national organization of the war savings committee of the United States Treasury Department. Through this committee the government placed on sale on Dec. 3, 1917, $2,000,000,000 of war savings and thrift stamps. Mr. Baily is devoting his time in interesting public utilities, including electric lighting, natural and artificial gas, water and street railway companies, in establishing booths for the sale of the new thrift and war savings stamps.

R. S. Dunning has resigned as secretary of the Cleveland Electric Club, Jovian Chapter, and is engaged in sales promotion work with the Forest City Rubber Company of Akron, Ohio. Under Mr. Dunning's secretaryship the Cleveland Electric Club was noted for the interest of its members and for the activities of the organization.

William Marconi, the inventor of the Marconi wireless system, has been appointed Italian high commissioner to the United States. Last spring Mr. Marconi, who is an Italian senator, was a member of the Italian commission which visited the United States. On his return from this country to Italy he served on the staff of General Diaz, the Italian Commander in Chief, giving special attention to the wireless system at the front.

Charles R. Underhill, chief electrical engineer of the Acme Wire Company, New Haven, Conn., has just been appointed captain in the Aviation Section of the Signal Reserve Corps. Mr. Underhill, who has been with the Acme company since the summer of 1911, is the inventor of a number of signal and wireless-telegraph devices besides being the author of a work on electromagnetic winding in which a number of original formulas are given.

F. Emerson Hoar, for five years head of the gas and electric department of the Railroad Commission of California, is leaving for Petersburg, Va., for three months' training as a captain in the Engineers' Corps. Mr. Hoar, who was born forty years ago in Kern County, California, served during the Spanish-American War with Company I, First California Volunteers, the regiment which took Manila. After the war he remained at Manila two years, working there as a civilian in engineering work. It is with the greatest reluctance that the Railroad Commission releases Mr. Hoar from his present important work, which includes investigation of the feasibility of interconnecting transmission line systems of the State and otherwise conserving fuel and power generally. Within the past year Mr. Hoar has had charge of very important studies in connection with oil resources, industrial power rates and, in fact, all of the larger problems brought before the commission in which gas and electric utilities are involved.

Obituary

Charles J. Klein, inventor, connected with the push-button specialties department of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., was stricken with apoplexy on Dec. 16, at the age of fifty-five years, death resulting. Mr. Klein was born in New York City and had been connected with the electrical industry in its early stages, having been associated with Mr. Edison in the installation of the first electric station in New York City. A number of products have been developed by the Cutler-Hammer company from the patented push-button mechanisms devised by Mr. Klein.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

Electrical League of Cleveland.—Mrs. C. S. Hoover addressed the Electrical League of Cleveland on Jan. 10 on the subject of "The War Work Done by the Daughters of the British Empire."

Empire State Gas and Electric Association.—The electric section of this association held a meeting on Jan. 18 at Rochester, N. Y., to discuss war economies, interconnection of systems and transformer loads.

Indiana Engineering Society.—The thirty-eighth annual meeting of the Engineering Society will be held at Indianapolis Jan. 25. The meeting, instead of being a three-day affair as usual, will be a one-day meeting with three full sessions. Separate meetings for different branches of engineering will be held. Charles Brossman, Indianapolis, is secretary of the society.

Fifth National Foreign Trade Convention.—The Fifth National Foreign Trade Convention will be held April 18 to 20 in Cincinnati, the convention theme to be "The Part of Foreign Trade in Winning the War." A tentative list of topics to be discuseed at this meeting is as follows: "After-War Conditions of Foreign Trade," "Exports Control and Imports Control," "Foreign Credits," "Education for Foreign Trade," "The Smaller Manufacturer and Merchant," "Getting Into the Game" and "The Merchant Marine." Delegates are urged to advise, in writing, the secretary of the National Foreign Trade Council, 1 Hanover Square, New York City, what group sessions they desire to participate in, specifying the phase of the subject in which they are interested.

Meeting of Brooklyn Company Section, N. E. L. A.—At the Jan. 15 meeting of the Brooklyn Company Section of the National Electric Light Association the chief speakers were W. H. Wells, advertising manager; W. F. Wells, vice-president and general manager, and T. I. Jones, general sales agent of the company. Mr. Jones' paper formed the chief topic of discussion for the evening. He reviewed briefly the sales activities of the Edison company for the year 1917, showing the results in curves. During the year 1917 a change was made in the sales policy of the Edison company, particularly with reference to incandescent lamps, and the new policy was outlined by Mr. Jones. Among the visitors were a number of prominent central-station executives and manufacturers' representatives in the district. Short addresses were also made by C. G. M. Thomas, treasurer of the Consolidated Gas Company of New York; Adam Page of the Harrison Lamp Works of the General Electric Company; D. F. Atkins, electrical engineer, Department of Water Supply, Gas and Electricity; W. J. Clarke, vice-president Westchester Lighting Company, Mount Vernon, N. Y.; O. H. Caldwell, *Electrical Merchandising*, and H. H. Barnes, engineer of the New York office of the General Electric Company.

Electric Club-Jovian League.—Capt. Charles E. Marian, chief examining officer for the Chicago district of the aviation department of the Signal Corps, addressed the Electric Club-Jovian League on Jan. 10. Announcement was made that the club's committee chairmen for 1918 are: R. I. Phillips, finance; E. A. Rummler, speaker; J. G. Harvey, entertainment; Norman F. Obright, reception; C. W. Pendell, attendance; George C. Keech, welfare; E. S. Butt, publicity; W. H. Coleman, permanent quarters; William P. Bear, war activities, and J. R. Cravath, civic committee.

New York Electrical Society.—Continuing the war series of meetings that have been running during the winter, the New York Electrical Society announces another of timely interest for Jan. 24 to be held in the Engineering Societies Building at 29 West Thirty-ninth Street. On this occasion the address will be "The Telephone in the World War." It will be delivered by H. J. Carrol of the New York Telephone Company's lecture bureau. The membership committee, under the chairmanship of Walter Neumuller, is engaged in a campaign which has secured more than 150 members.

Contractors and Jobbers Hold Meeting in St. Louis.—A meeting was held jointly by the co-operative committee of the St. Louis Electrical Contractors, Jobbers and Dealers and the Missouri State Association of the National Association of Electrical Contractors and Dealers in St. Louis on Jan. 5. Beginning with the morning session, the following chairmen of standing committees delivered reports: Industrial development, Gus Schwedler of the Sparks Electric Company, Kansas City; universal data and sales book, O. L. Fickie of the Union Electric Company, Kansas City; liability insurance, W. L. Hutchison of the Kansas City Electric Construction Company; merchandising, J. J. Magee. In the absence of E. L. Heath, chairman of the credit committee, W. J. Burton of the Frank Adam Electric Company, St. Louis, presented a paper on "The Value to the Contractor of Trade Acceptances." The time being limited, the following committees were unable to report: House wiring, Robert B. Randall, chairman; jobbers, W. A. Koeneman; central stations, George Gamp; architects and engineers, W. J. Sutter. These additional committees were created: Unit prices, Edward Allison of the W. A. Corrao Electric Company, St. Louis, chairman; also standard forms and accounting and standard costs, with the selection of chairman deferred.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Continuous Service Rate.—The Pennsylvania Public Service Commission, in a case affecting the Butler Light, Heat & Motor Company, holds that when a company purchasing electric power from a power company must have continuous service and cannot bring itself within those provisions of the schedule of rates of the power company limiting the service to off-peak hours, it cannot demand the off-peak-hour service rate but must pay the continuous service rate.

Providing Working Capital.—Working capital is considered by the New Jersey Board of Public Utility Commissioners in a case affecting the Tintern Manor Water Company, the decision declaring: "It may well be that a company is required to borrow money in order to finance its operations, but this fact alone is not clear evidence that an allowance of working capital should be made. Where bills are payable entirely in advance at the beginning of the year, the money required to operate the company for the year is deposited to the credit of the company and may be actually increased, owing to interest on bank balances."

Method of Accounting for Service.—The method of recording messages used by the New York Telephone Company—having the operator press an electric button connected with a recording machine as soon as a call has been completed—was found by the New York Public Service Commission, Second District, to be as nearly accurate as any registering system which depends in any degree upon the accuracy of the people operating it. "So far as the commission has been enabled to observe," the decision says, "the company has always tried to avail itself of the best appliances that are to be had and to maintain a high standard of efficiency in the conduct of its business. Its failure to give entire satisfaction in connection with the matter now under discussion has not, in the opinion of the commission, been due to any desire upon the part of the company to maintain a registering method that is only partially satisfactory for one minute longer than seems necessary for the good of the system as a whole. If the commission did not believe that this was so, it would regard the condition of which Dr. Tracy [the complainant in the case] complains as intolerable, and would be willing to go to almost any length in compelling the company, at whatever cost, to rectify it immediately. Believing it to be so, it feels that this whole matter can be allowed to rest where it is for a while longer, until some better solution presents itself."

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

SEPTEMBER ELECTRICAL EXPORTS COME TO $4,190,110

The Large Amount of $773,217 for Insulated Wire and Cable Included in Figures for the Month's Total

During September last exports of electrical goods from the United States amounted to $4,190,110, in comparison with $3,491,217 in September, 1916. These figures included an item of $773,217 for insulated wire and cable armament, which is particularly large for that trade.

Figures also show exports of electrical goods for the first nine months of 1917 to have been $40,225,951, as compared with $27,027,623 for the corresponding period of 1916 and $17,239,950 for the corresponding period of 1915. From the figures for the first three quarters, it appears that the total for 1917 will be somewhat more than $50,000,000. However, the shipping conditions of the fall months of 1917 were such that it would not be surprising if the figures for those months when disclosed should show a considerable falling off over the previous months of the year.

The following figures were compiled by the Bureau of Foreign and Domestic Commerce:

Articles	1916	1917	1916	1917
Batteries	$157,051	$187,665	$1,331,054	*$2,568,047
Carbons	.....	96,297	.....	336,180
Dynamos and generators	108,453	106,784	1,129,872	1,718,005
Fans	23,593	65,558	255,231	487,330
Heating and cooking apparatus	.....	39,927	.....	*85,396
Insulated wire and cables	513,946	773,217	3,012,318	5,491,054
Interior wiring supplies, including fixtures	71,840	64,713	646,624	929,764
Arc lamps	982	1,193	12,946	13,415
Carbon-filament lamps	7,541	6,948	71,570	138,317
Metal-filament lamps	86,539	205,793	1,066,637	2,013,975
Magnetos, spark plugs, etc.	.....	239,724	.....	*712,345
Meters and measuring instruments	85,395	111,906	624,242	808,181
Motors	327,727	456,117	3,467,002	*4,586,287
Rheostats and controllers	.....	4,882	.....	*37,845
Switches and accessories	.....	166,299	.....	466,897
Telegraph apparatus, including wireless	10,671	17,707	120,761	470,351
Telephones	69,933	106,758	1,217,793	1,495,245
Transformers	103,251	88,660	801,935	1,038,650
All other	1,924,295	1,450,962	13,269,638	16,828,667
Total	$5,491,217	$4,190,110	$27,027,623	$40,255,951

*Figures cover period beginning July 1.

THE GROWING SCARCITY OF SKILLED MECHANICS

Appliance Manufacturer Unable to Place New Line of Goods on the Market Owing to Labor Shortage

Added to the difficulty of obtaining an adequate and steady supply of raw material, such as aluminum, brass, copper, steel, etc., a manufacturer of vacuum cleaners and other household appliances states that the growing scarcity of labor is becoming a real menace. As yet no attempt has been made to train and introduce women into this plant, but as could be gathered it seems only a question of time. For example, where in one department the complement was twenty-five men—this is a moderate-sized factory—now four is the largest number that can be had; in another department, where fifteen men were employed, two now report for work; in still another room, where ten skilled men were necessary, only one man is on hand. The manufacturer in question, in lamenting this state of affairs, remarked that there seemed to be no relief in sight.

With the rapidly diminishing staff of factory workmen—skilled mechanics in their respective lines—has come the rapidly advancing scale of wages. The munition plants are attracting the services of mechanics, especially metal workers, as in this case, by paying them three times the money a manufacturer of the kind referred to can afford if he is to market his specialties with any margin of profit remaining. The cost of production follows the various increases of wages, so that the danger point has been reached.

For some time this producer was, and he is yet, hoping to place on the market a new line of electrical goods. The raw material is assembled and ready to be put in process, but the labor is the "missing ingredient" that is blocking further progress. The entire force of the factory must devote its time to keeping his regular lines in shape, which leaves any expansion along new lines almost impossible. Just how many other plants are either ruefully contemplating a like condition or else already experiencing it a special investigation alone would determine.

THE VOLUME OF HEATING DEVICE BUSINESS IN 1917

Gross Sales of All Companies Are Estimated by Competent Authority to Be $5,000,000, Which Is $1,000,000 Ahead of the Figures for 1916

An authority on heating-device sales, whose knowledge of the entire business is gained through close association with the resistance-wire patent control, has given the following data as the best obtainable on the field as a whole:

"Heating-device sales for the year 1916 were $4,000,000 and for 1917 were $5,000,000 at manufacturers' prices. This total volume was divided in the proportion of 60 per cent socket appliances and 40 per cent ranges and other devices. If it be assumed, as it may be conservatively, that $5 is the average selling price per socket device and $60 is the average price per range, it is apparent that 400,000 socket devices and 50,000 ranges and other devices were sold in 1917. The average connected load of socket devices may be taken at 660 watts. On this basis the sales of 1917 alone added to the lines of central stations 264,000 kw., or a demand which if produced simultaneously would amount to a peak five-eighths as great as the peak of the Commonwealth Edison Company in Chicago in 1917. A little further estimating, based on published data on heating device use (see ELECTRICAL WORLD, July 7, 1917, page 19), shows that this 264,000 kw. of connected load meant annually an energy consumption of 40,429,600 kw.-hr. At 5 cents per kilowatt-hour this means $2,021,480 in central-station revenue. Likewise, with the electric ranges a 5-kw. average rating can be assumed, giving 200,000 kw. in ranges sold during the year, or more than enough entirely to load to its ultimate capacity the new Windsor (W. Va.) power house jointly owned by the American Gas & Electric Company and the Insull interests. The central-station revenue from these ranges will probably be not less than $36 a year each, or $1,500,000. In other words, there is no single electric light and power company in the world capable of carrying the total connected load which would be produced if all the heating devices, including ranges, etc., sold in 1917 were simultaneously connected to its lines. The importance of this fact is more appreciated when it is considered that heating devices in quantities nearly as large have been sold

for many years and are still operative. It should also be pointed out that each 1000 kw. of heating devices connected calls for its quota of boilers, turbines, generators, switchboards, feeders, substations, transformers, wire, meters and supplies. Thus the 464,000 kw. of heating devices of necessity made possible the sale of much other equipment. Of such sales the size of the item of meters alone is surprising, since a very large percentage of the 50,000 ranges necessitated the purchase of three-wire, 25-amp. meters. So, taken on the whole, the heating device business is not the 'piddling' little affair it is sometimes assumed, in ignorance, to be."

ELECTRICAL SUPPLIES FOR THE GOVERNMENT

Bids Now Being Asked for Considerable Quantities of Wiring Equipment—List of the Desired Articles

Bids are being asked for by the General Engineer Depot, Washington, D. C., for furnishing a considerable quantity of electrical goods to the government. Proposals will be opened Jan. 21. The electrical goods which the government is calling for are listed in the following table:

1600 lightning arresters, 2500 volts.
1600 gapments for above.
1600 350-volt lightning-arresters.
8000 guy anchors.
160,000 galvanized cross-arm braces.
480,000 malleable-iron wall brackets.
160,000 oak brackets.
1600 linemen's tool belts.
8,200,000 unglazed porcelain cleats.
160,000 cut-outs.
16,000 galvanized guy clamps.
1600 splicing clamps.
320,000 cable connectors.
648 fuse plugs.
148,000 inclosed fuses.
3200 lb. round fuse wire.
1600 fuse boxes.
12,000 fuse links.
400 wire grips.
1250- 400 linemen's slack tackle.
3200 enamel hoods.
1600 linemen's hatchets.
2200 hatchet handles.
832,000 glass insulators.
24,000 porcelain knobs.
480,000 locust insulator pins.
555 kerosene fire pots.
555 melting pots.
80,000 connecting plugs.
480,000 porcelain rosettes.
480,000 reflectors.
800 wire reels on wheels.
3200 reducers.
400 tube cutters.
400,000 lb. friction tape.
9600 copper terminals.
36,800 cable taps.
1600 safety straps.
769,600 porcelain tubes.
480,000 sockets.
160,000 snap switches.
36,000 D. P. S. T. knife switches.

METAL MARKET SITUATION

Wire Is Following Base in a Downward Tendency—Lead, Brass and Aluminum Are Higher

No uneasiness is expressed by either manufacturing consumers or jobbers regarding the supply of copper. The metal is moving freely at the established price, and wire—bare, covered and weatherproof—is being shaded in price, according to reliable reports. When the transactions have seemed to warrant the reduction base was quoted as low as 28 cents and weatherproof at 26½ cents. The jobbing houses in some instances are speaking of the current situation, especially on wire, as a falling market; but prices remain fairly steady for usual requirements.

Lead has advanced, as well as aluminum. Old metals also reflect an upward tendency, with brass following in the same way. Tin is still scarce; in fact, buyers are placing orders at the convenience of the market, with none offering.

NEW YORK METAL MARKET PRICES

	Jan. 7	Jan. 14
Copper:	£ s d	£ s d
London, standard spot	110 0 0	110 0 0
Prime Lake	Govt. price 23.50	Govt. price 23.50
Electrolytic	Govt. price 23.50	Govt. price 23.50
Casting	Govt. price 23.50	Govt. price 23.50
Wire base	27.00*	27.00*
Lead, trust price	6.50	6.75
Nickel, ingot	50.00	50.00
Sheet zinc, f.o.b. smelter	19.00	19.00
Spelter, spot	7.82½ to 7.92½	7.82½ to 7.92½
Tin, Straits	85.00*	85.00*
Aluminum, 98 to 99 per cent.	34.00 to 36.00	35.00 to 37.00

OLD METALS

Heavy copper and wire	22.00 to 22.50	21.50 to 22.00
Brass, heavy	14.00 to 14.50	13.75 to 14.00
Brass, light	10.00 to 10.50	10.00 to 10.50
Lead, heavy	6.00 to 6.12½	6.25 to 6.37½
Zinc, old scrap	5.00 to 5.50	5.00 to 5.50

*Nominal.

THE WEEK IN TRADE

REPORTS from all sections indicate a brisk opening of trade so far in January. Shipments and deliveries continue to be disastrously affected by freight and express embargoes, with not much improvement in the transportation congestion at the principal terminal points. Business, however, is sound and increasing in volume. A few price advances have been made during the week, notably on friction tapes and electric sewing machines. Severe weather conditions have held up the supply of heating appliances, and an acute shortage in the large cities in the East has followed. In certain sections some kinds of conduit, as well as large and small motors, are scarce, with lamps still short. Building operations show some improvement, particularly where governmental activities along war lines exist. Financially the trade is reported to be on a sound basis, collections being generally mentioned as fair.

NEW YORK

During the past week considerable activity in the further receipt and sale of heating appliances was in evidence. The continued severe cold weather and record-breaking snowstorms in the Middle West have interfered greatly with shipments. The outlook for better and more certain deliveries, which seemed on the point of improvement, is now somewhat dubious. Revision in price to a 30-cent base of wire products is in progress. Collections have fallen off to a slight degree.

TIME SWITCHES.—Apparently a stronger demand is developing. A manufacturer who specializes on these goods says that while prices have not changed recently deliveries cannot be made under six months.

COLLECTIONS AND CREDITS.—January so far is making only a fair showing on collections, although no uneasiness is displayed by the jobbing houses and distributers. Jobbers state that not a few manufacturers are making liberal discounts for prompt and anticipated settlement of bills; in fact, far in advance of maturity. This practice is being followed right down the line to the dealers. The money is needed to finance current obligations.

SEWING MACHINES.—An advance of from $2 to $3.50 on certain types of electric sewing machines is reported as immediately effective. The supply of stock in the factories is said to be none too large, though no shortage is in sight.

RADIATORS.—The New York distributing and jobbing trade has not had its stock replenished. From reliable sources it is ascertained that shipments of these goods are in transit, but no one seems to know where they are or when deliveries may be reckoned on with any degree of positiveness. During the recent cold snap one of the largest distributing concerns in the East had one radiator in its showrooms, and four officers of the company endeavored to commandeer it for their personal use at home. Several jobbers stated that they could have sold from 500 to 1000 heaters readily if it had been possible to procure them.

GEARS AND PINIONS.—With the drawback incidental to uncertain deliveries, gears and pinions of standard grades are coming through in a fair way. Where new goods cannot be had unless subject to long delays, the second-hand market furnishes the supply quite satisfactorily.

FRICTION TAPES.—New prices are being quoted in certain quarters on friction tapes, effective Jan. 14, the change representing a sharp increase, ranging from 15 to 25 per cent.

PORCELAIN.—A slight betterment of conditions is noted in porcelain goods, shipments of which are moving as well as the embargoes in the East will permit. No recent differ-

ence in prices has been made so far as could be learned from local jobbers.

SOCKETS.—Where a few weeks ago the supply of standard sockets was regarded as approaching a shortage, now there is no trouble in getting stock. Prices have not been changed, but a revision is looked for.

CHICAGO

Two blizzards which have swept over the Central West this week have pretty effectually tied up the trade. There were very few shipments arriving at the jobbing houses. What is more disastrous is that for several days the drifts cut off shipments from jobbing houses to customers. On Saturday, Jan. 12, it was even impossible to get out express shipments because street traffic was deadlocked. Express companies flatly refused to send out wagons and trucks. Orders have continued to come in, however, and in some quarters the comment is heard that in spite of the severe weather business for this season of the year is fair. Especially with industrial companies business remains good.

COPPER.—As was predicted last week, rubber-covered copper wire is down to a 30-cent to 32-cent base. Weatherproof wire can be bought as low as 28 cents. It is the opinion in the trade that the action of the authorities at Washington in again fixing the price of copper at 23.50 cents will give a stable market for the next four months.

PORCELAIN INSULATION.—Now that the government demand for standard porcelain for cantonment construction is past the peak, better deliveries on all porcelain goods are expected by the Chicago trade.

MOTORS.—The aeroplane and aeroplane parts factories which are being and have been established at various points in the Middle West have called for great quantities of standard electric motors. The business of these great new plants went in most cases to the firm which could deliver on demand. To meet the requirements for speed, motors were shipped from jobbing warehouses from coast to coast. The electrical goods, it is said, were always on hand when needed and did not delay the jobs.

BOSTON

Jobbers report a slight falling off in business, but this is looked upon as temporary. Government orders predominate, as usual in these days. The freight congestion on the railroads is a severe handicap to deliveries, both of raw materials and finished products. Heavy storms in the Middle West are indirectly affecting New England transportation facilities, and disadvantageously. Prices remain steady, an advance being looked for, however, in insulating tape in the near future. Lead-covered cable is quoted somewhat higher, owing to a recent advance of about 0.5 cent per pound in lead.

Mill and government collections remain in the gilt-edged class, but jobbers report little improvement in contractors' payments. In some cases central-station remittances are reported as slower than usual, but no fear appears to be abroad as to the fundamental soundness of such customers. The coal situation remains very serious.

The Narragansett Electric Lighting Company of Providence, R. I., expects to start service with a 45,000-kw. turbogenerator this week, materially relieving the power situation through the interconnected transmission lines. This company will shortly purchase $25,000 more of electric motors and is optimistic as regards 1918 business.

MOTORS.—Stocks are improving in smaller sizes, but there is a decided shortage in units of more than 75-hp. rating. Government demands for large motors are unceasing. Prices remain firm, with no immediate prospect of a change, and deliveries show little improvement. Not infrequently motors are diverted to central-station customers en route from the factory to the stockroom.

METERS.—The low volume of house-building contracts has cut down the sale of meters to less than three-fourths of the normal rate. Factory stocks are accordingly improving against expected future demands. Prices steady.

TRANSFORMERS.—Deliveries of six to eight months are quoted on transformers of 100 kw. and more for industrial work, with about half this period on priority orders and on small units. Demand continues heavy with prices firm.

LAMPS.—The general supply situation improves. Curtailment of use to save fuel is now being felt in the trade, especially in sign lamps. Factories are seizing the opportunity to stock up on these small sizes. Glass shortage is upsetting some producers, and transportation delays, combined with breakages from rough handling, are rather burdensome. The labor supply has been studied effectively at the factories and the effect of the draft has been discounted. Pooling shipments in a single carload has not always worked well, in view of delays in transit. In one typical case a pooled shipment took five weeks as compared with five days' normal time between factory and distributer. Business holds good, despite the 10 per cent price advance of Jan. 1.

CONDUIT.—Jobbers' stocks are getting low and deliveries are getting poorer, owing to railroad embargoes. The mills are finding raw-material deliveries unsatisfactory. So far prices remain steady.

ASBESTOS INSULATION.—Deliveries are improving somewhat in ebony wood, and prices show little change. There is no local stock of plain asbestos wood reported by one large dealer.

FIBER CONDUIT.—Business continued brisk up to Jan. 1. Frozen ground accounts for a lull at present. A good deal of construction is expected this year in war-service plants.

ELECTRIC HEATERS.—Large sales are registered, one jobber's turnover running into thousands, with a demand great enough to warrant sending the purchasing agent to the factory.

ATLANTA

The general undertone of the electrical business, despite the many existing hindrances and elements of uncertainty, appears more confident, though there is no disposition to minimize the possible effects of further economic changes.

The intensely cold weather experienced in the Southeast lately, with storms in some sections, has interrupted business more or less generally, aggravating the already serious fuel and transportation problems, accentuating the difficulties in distribution and slowing up construction. While the fuel situation in the Southeast has shown a slight improvement this week, the necessity for further relief is still great, especially at industrial centers, where the fuel requirements are in excess of normal on account of the increase of government orders and shortage of rainfall.

The protracted drought is now being felt by hydroelectric companies, which experienced practically no difficulty from this source during December.

The consensus of opinion among the jobbers and manufacturers is that the volume of electrical business for 1918 will be even greater than that recorded in 1917. The optimistic feeling is engendered, no doubt, by the fact that a large amount of capital will be invested in shipbuilding at the Southeast coast cities, which will also require the expenditure of a big portion of the $35,000,000 recommended by the Shipping Board to house workmen engaged at these points. Then, too, work is just being started on the Muscle Shoals nitrate plant. Information secured from reliable sources indicates that one of the government repair shops will be in Atlanta. It is expected that the general contract will be let this week calling for the expenditure of approximately $1,750,000 covering this structure. Reports from Nashville, Tenn., state that the Du Pont Company, Wilmington, Del., contemplates the erection of a ninety-million-dollar plant on the Cumberland River, Tennessee, under government supervision.

FRICTION TAPE.—The demand is very heavy. Prices are up 40 per cent over January, 1917, this class of goods naturally following the price of cotton. Deliveries are reported as being good.

SOLDER.—This item closely follows the tendency of friction tape in demand, but prices have not advanced so

rapidly, being 20 per cent up over this period last year. Deliveries are good also.

LAMP GUARDS.—The recent advance in the price of lamps has stimulated this line, and a brisk trade is noted. Jobbers say that this activity is actuated by new year economies effected in lighting and lamp purchases by industrial plants. Deliveries are very good and prices firm.

PORCELAIN.—The call continues strong, and no price advance has been noted during the last thirty days. Jobbers report deliveries poor, running from four to six weeks.

WIRING DEVICES.—The class of goods used for inside purposes is in great demand and the volume of business is considerably above normal. Factory promises and shipments are fair, but deliveries have not been so good recently.

WIRE.—Prices have been weakening slightly during the past month on rubber-covered and weatherproof. Shipments are bad.

RECTIFIERS.—Considerable activity is noted in these for service with lighting and starting batteries, and an excellent business is being done. Up to a few weeks ago local stocks were in comparatively good shape, but transportation difficulties have affected these also and stocks are becoming depleted.

SEATTLE

Northwest jobbers, in Seattle particularly, report a noticeable increase in buying. January to date in sales to shipyards and industrial plants far outstrips the same month last year. This increase in sales is due to the number of shipyards and allied plants as compared with last year. It is believed the volume of sales to shipyards which now obtains will continue increasing throughout the present year. Jobbers generally are buying heavily since annual inventories were taken in an effort to fill stocks before drastic steps are taken by the government to eliminate manufacture and shipments of so-called non-essentials. Prices are standing still. Three-quarters-inch black conduit is exceptionally hard to get. There is a shortage of both large and small motors and a distinct shortage in lamps.

A perceptible impetus has been felt along building lines in both Seattle and Tacoma since the first of the year. This applies to residence building solely, to care for 20,000 shipyard employees whom the government intends placing in Puget Sound cities. It is announced that the government does not plan to erect dwellings to care for workers, but depends upon property owners to prove their civic and patriotic spirit by building on unimproved lots to care for the influx. The mobilization of skilled labor for war purposes is to receive its first test in Seattle. Electrical dealers, specifically, feel the effects of the residence building program under way. Sales of wiring materials, fixtures, lamps, bells, etc., are increasing daily. Jobbers are caring for the demand easily. The commercial boat and yacht builders and machinery houses are having a hard time meeting the extraordinary demand for craft, both for commercial purposes and pleasure. Electrical dealers are doing a neat business with these concerns.

The United States Shipping Board recently announced, in spite of reports to the contrary, that wooden shipbuilding plants in the Seattle district will continue to receive government contracts to their full capacity as long as prices and deliveries are satisfactory. Additional contracts for Puget Sound yards are now being arranged.

For the first time in two weeks normal train service over all transcontinental lines has been resumed. Although freight shipments from Eastern points were delayed, jobbers were not seriously inconvenienced and the shipbuilding program was not halted noticeably. Deliveries long past due are coming through slowly. Advantages predicted when the government took over the railroads, such as the intra-terminal shipping maximum loading of cars, have not yet materialized. Much of the freight congestion at Northwest lumber mills, however, has been relieved.

On flood lamps an increasing demand is noted from several sources, particularly shipyards and government cantonments. Stocks seem ample. Sales, however, are expected to decrease with the coming of spring. There has been no noticeable change in prices for months. Farm lighting outfits continue moving well, although a large volume of sales were made prior to the holidays. The campaigns conducted in the fall and early winter are declared very successful, especially among farmers in eastern Washington.

Switchboard instruments and switches of all kinds are moving very satisfactorily. Stocks are in fair condition and prices remain steady. Telegraph and telephone apparatus is moving very slowly. A majority of the sales are for repairs and maintenance. The recent storms and the subsequent damage to lines in the upper Sound country resulted in a slight increase in the buying of wire, insulators and pole-line materials. The volume of sales is very small. Electric glassware fixtures and the like are moving faster. There are ample stocks and even prices. Some jobbers are ordering for spring deliveries. Sales are expected to exceed by far last year's record on account of the anticipated increase in residence building. Flashlamps and flashers are moving fairly well. There had been a heavy movement, but sales are now smaller. A shortage of this merchandise is at hand and deliveries are very slow. Jobbers are ordering heavily. No increase in prices is noted.

Credit managers, as a whole, report that collections during 1916 were considerably better than in 1917. This applies to all months excepting December last, and to all credits with the exception of the government. However, government collections are improving steadily, owing, it is said, to more expeditious and efficient handling of supplies. Government purchases for the navy, from which Seattle jobbers derive a large business, are not paid for until ten days after the merchandise is inspected and approved. Heretofore in many instances goods were not inspected for months after delivery on account of the enormous volume. This necessarily made collections slow. Very few new credits of any size were placed since the first of the year. Credit managers say, however, that there is no occasion for pessimism and that undoubtedly 1917's record for business will be equaled if not exceeded this year. December's collections were easy and highly satisfactory.

SAN FRANCISCO

Beginning immediately after the holidays, building activity in San Francisco increased remarkably. During the months of November and December there had been very much less than the usual construction, particularly in apartments, hotels and office buildings, but in the first twelve days of January the city building department reported having passed upon a greater amount of work than the total for the months of November and December. Many of the new structures are machine shops, garages and warehouses, with a few loft buildings. The inquiries now regularly being made at the building inspector's office indicate that activity in this line will probably continue for some time.

The petroleum industry constitutes an important feature of California trade and construction activity just now. From the oil districts in the vicinity of Coalinga and Taft, and, in fact, wherever oil fields are tapped by the long-delivery pipe lines, the demand for electrical equipment has been steady and very heavy. Producers' committees have been successful in securing special priority orders on motors and other equipment for oil-field use. Transportation has been receiving careful attention, and especial effort is being made to increase warehouse and terminal storage space. In response to the Railroad Director's appeal for freight clearance, a committee was last week formed in San Francisco which released 200 freight cars for service within forty-eight hours.

At a hearing before the Railroad Commission this week, at which the advantages of interconnection of transmission lines were discussed, complaint was made that power companies are getting into bad shape financially because of increasing costs and unchanging rates. The construction of hydroelectric development is held up on this account, and a power shortage is predicted as a result, because industrial demands in the bay region are rapidly increasing and even the present sources of supply are barely sufficient. Moreover, the California rainfall this winter has thus far been the least recorded in sixty-nine years and water power next season will be affected accordingly.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages or specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the source of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B.&S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List to $61.00
Coil to 1000 ft	— 5% to $59.17
	No. 12 Solid
Less than coil	List to $71.00
Coil to 1000 ft	—10% to $68.87

Twin-Conductor

	No. 14 Solid
Less than coil	List to $105.00
Coil to 1000 ft	$70.00 to 10%
	No. 12 Solid
Less than coil	List to $135.00
Coil to 1000 ft	10% to $130.95

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	List +10%
Coil to 1000 ft	List —10%
	No. 12 Solid
Less than coil	+10%
Coil to 1000 ft	—10%

Twin-Conductor

	No. 14 Solid
Less than coil	List +10%
Coil to 1000 ft	List —10%
	No. 12 Solid
Less than coil	+10%
Coil to 1000 ft	—10%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	List to 10%
1/5 to std. pkg	15% to 20%
Std. pkg	28% to 34%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to 12%
1/5 to std. pkg	20%
Std. pkg	28% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28 to .285	.29 to .295

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.3175	.3275
Barrel lots	.2875	.2975

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, Per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less Than Coil	Coil to 1000 Ft
3/4-in. s. stp.	Net to $75.00	—12% to $69.75
3/4-in. d. stp.	+10% to 75.00	— 9% to 72.00
1/2-in. s. stp.	List to 100.00	—12% to 93.00
1/2-in. d. stp.	Net to 100.00	— 9% to 96.00

NET PER 1000 FT.—CHICAGO

	Less Than Coil	Coil to 1000 Ft.
3/4-in. single strip	$75.00	$63.75
3/4-in. double strip	78.25-78.75	71.25
1/2-in. single strip	100.00	85.00
1/2-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List Per Foot	Size, In.	List Per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00-$55.00	$20.50-$24.75	$20.00-$22.00
1/4-in.—	$28.00-$60.00	$22.50-27.00	$22.00-$24.00

NET PER 1000 FT.—CHICAGO

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in., Net to	$55.00	$25.00-$37.50	$22.50-$24.75
1/4-in., Net to	$60.00	$27.00-$30.00	$25.00-$27.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37
2 1/2	.58 1/2
3	.76 1/2

	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	4% to 6%	7% to 9%
2500 to 5000 lb.	6% to 8%	9% to 11%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	1.3% to 3.7%	4.3% to 6.7%
2500-5000 lb.	3.3% to 5.7%	6.3% to 8.7%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$5.00 to $6.00
Discount	25% to 30%

CHICAGO

List	$5.00 to $6.00
Discount	30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.00 to $5.75
1/5 to std. pkg.	4.50

Standard package, 500. List, each, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard package, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.30
60-watt—B	100	.35
100-watt—B	24	.70
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round bulbs, 3½ in., frosted:		
15-watt—G 25	50	.53
25-watt—G 25	50	.55
40-watt—G 25	50	.55
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.77
Round bulbs, 4¾ in., frosted:		
100-watt—G 35	24	1.10

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	Net
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$24.90 to $31.00
Coil to 1000 ft.	22.72 to 27.90

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00 to $35.60
Coil to 1000 ft.	22.50 to 26.70

LAMP GUARDS, WIRE

Standard packages from 50 to 150.

NEW YORK

Net per 100	$20.00 to $29.00

CHICAGO

Net per 100	$19.25

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, AX, 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S. 1½, 3 R.	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	25%-37%	20%32%
$10.00 to $50.00 list	42%-45%	37%-40%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $38.00
1/5 to std. pkg.	19.00 to $20.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80
1/5 to std. pkg.	14.80

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	Std. Pkg. 3500 5½ N. C.	Std. Pkg. 4000 —Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$27.50 to $29.00	$30.75
1/5 to std. pkg.	15.60 to 20.75	24.20

CHICAGO

Per 1000 Net	Std. Pkg. 3500 5½ N.C.	Std. Pkg. 4000 —Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$11.85	$30.75
1/5 to std. pkg.	11.10	24.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15% to 20%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	14%
1/5 std. pkg.	30%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.33
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	List to + 5%
$10 to $25 list	10% to 11%
$25 to $50 net	14% to 15%
	Low Grade
Less than $10 list	5% to 10%
$10 to $25 list	16%
$25 to $50 list	24% to 25%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+5%
$10 to $25 list	—10%
$25 to $50 list	—14%
	Low Grade
Less than $10 list	—5%
$10 to $25 list	—16%
$25 to $50 list	24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	List
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to list
1/5 to std. pkg.	List to —15%
Std. pkg.	List to —30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List	+ 10%
$2.00 to $10.00 list	10% to 20%	10%
$10.00 to $50.00 list	20% to 30%	20%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25%	15% to 20%
$2.00 to $10.00 list	25%	20%
$10.00 to $50.00 list	25% to 35%	20% to 25%

TOASTERS, UPRIGHT

NEW YORK

List price	$5.00 to $7.50
Discount	25% to 30%

CHICAGO

List price	$5.50 to $6.00
Discount	30%

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

	Per Lb. Net.
No. 18, less than full spools	$0.44¼
No. 18, full spools	0.43¼

CHICAGO

	Per Lb. Net.
No. 18, less than full spools	$0.64 to $0.65
No. 18, full spools	0.54 to 0.55

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net— Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
No.			
11..	$15.00-$18.00	$13.00-$14.00	$11.00-$11.50
12..	23.25- 25.41	21.30- 21.78	15.97- 19.35
10..	32.40- 35.21	29.70- 30.18	22.13- 27.00
8..	45.70- 49.12	41.90- 42.12	30.88- 38.00
6..	72.40- 77.84	66.35- 66.72	48.93- 60.30

CHICAGO

	Price per 1000 Ft. Net— Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
No.			
14....	$18.00	$13.00	$11.50
12....	25.33-25.69	22.02-23.82	18.35-19.85
10....	30.48-33.24	27.94-30.03	22.86-27.70
8....	42.54-47.04	38.99-41.98	31.90-39.20
6....	66.46-67.38	56.15-62.05	50.53-55.85

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$33.25 to $35.25
25 to 50 lb.	31.21 .....
50 to 100 lb.	28.25 to 34.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$40.00 to $40.35
25 to 50 lb.	39.00 to 39.35
50 to 100 lb.	38.00 to 38.35

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Vertical Rotative Dry-Vacuum Pump

Attention is called to the fact that the vertical type of dry-vacuum pump manufactured by the Wheeler Condenser & Engineering Company of Carteret, N. J., is in demand by ship and stationary plant builders who are anxious to save as much space as possible and who at the same time have their eyes open to economy. Where much condensing is to be done and where high vacuum is to be maintained it is generally best to install separate condensate and air pumps. Thus a motor or turbine-driven centrifugal hot-well pump can easily take care of the condensate while this Wheeler dry-vacuum air pump withdraws the air.

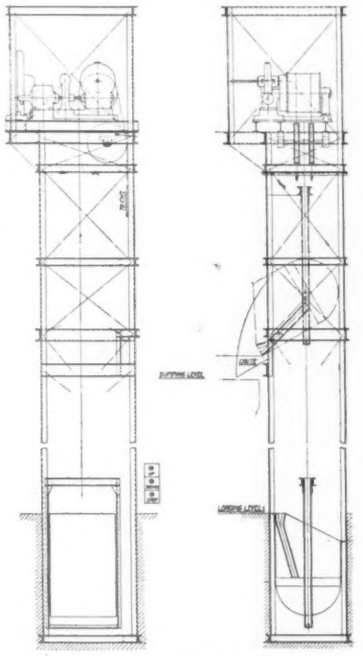
The inlet valves of this vacuum pump are of the semi-rotative type, which are so manipulated by the valve gear as to draw air from the condenser during its full stroke. Clearance difficulties are eliminated in this design of valve gear by providing ports which register with an equalizing passage. The discharge valves are of the poppet type and are easily accessible. In fact, all parts are easily accessible, a point that is of great value in high-vacuum pumping machinery. Valve arrangement is such as to insure perfect drainage at all times.

The makers point out that a motor-driven dry-vacuum pump has numerous other advantages over direct steam drive, among which are ease of installation, less attention required, no steam pipe radiation losses, and improvement of plant load factor.

Skip Hoists

Automatically operated skip hoists for the speedy and efficient handling of coal, ashes and similar materials in gas plants, central stations, mining plants, factories, etc., have been developed by the Otis Elevator Company of New York City. These skip hoists may be divided into two classes according to whether the bucket for carrying the load travels vertically or on an incline. Both vertical and incline hoists may be equipped with a single hoisting bucket, which may or may not require a counterweight, or with two hoisting buckets running on separate tracks, the one acting as the counterweight for the other. For the duties generally found in handling coal, ashes, etc., in manufacturing plants and central stations standard elevator hoisting machines are used. These can be installed either overhead or at ground level, adjacent to the hoistway. The usual machine consists of a single or double drum, a worm-gear reduction, an electrically released, spring-applied shoe brake and a motor, all of these parts being mounted on a heavy cast-iron base plate to preserve alignment.

The control system generally furnished is entirely automatic. The operation is by means of three push-buttons marked "up," "down" and "stop." When the bucket has received its load the attendant presses the "up" button, which causes the machine to start, and from this point the operation is entirely automatic. The machine accelerates to full speed, the bucket rises to the upper



DETAILS OF AUTOMATICALLY OPERATED SKIP HOIST

level, and at the proper point the machine slows down and the bucket travels into the dumping position, where on single skips it stops and automatically remains for a predetermined interval which is sufficient to allow the material to be entirely discharged from the bucket. The machine then automatically starts in the "down" direction and continues in operation until the bucket reaches the lower level and automatically stops in the loading position. A pressure of the "stop" button at any time during the travel of the bucket will cause the machine to come to rest.

In the case of a double skip hoist, when the ascending bucket reaches the dumping position the machine remains stationary until it is again started by the operator at the loading point, the operator having in the meantime attended to the loading of the other bucket.

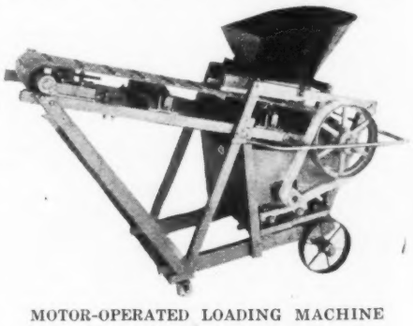
The bucket usually furnished for vertical skip hoists, either of the single or double skip type, is made of heavy steel plates reinforced with structural shapes and provided with two cams symmetrically placed on each side of the bucket. These cams are made of channels or angles properly shaped and riveted to the bucket. The bucket is supported in a steel frame or sling by means of two trunnions and is held in an upright position and guided during its travel by means of two steel brackets bearing against angle-iron guides.

Renewable Fuse

The Chicago Fuse Manufacturing Company of Chicago is marketing the fuse it has purchased from the Multi Refillable Fuse Company under the trade name of "Union." The present form of the fuse is the result of extensive experiments and improvements. The tubing used is the best-quality horn fiber of extra thickness. The ferrules and caps are of brass and designed to withstand the heavy strains incident to a fuse without powder filler. The method of attaching the cap allows an exceptionally heavy pressure to be brought to bear upon the contact with the end of the renewable element, thus reducing the heat developed to a minimum and guarding against accidental loosening of caps through rough usage.

Car-Loading Machine

The Link-Belt Company of Nicetown, Philadelphia, Pa., has recently put on the market a low-priced machine for loading all kinds of material into box cars. The machine is shown in the accompanying illustration and is called the Link-Belt BX loader. It is a portable machine, driven by motor or gas



MOTOR-OPERATED LOADING MACHINE

engine, and handles the material delivered to it through the steel hopper on a flat belt. On a recent test it loaded eighty box cars in six days with but two men. Its capacity is 80 tons to 100 tons per hour.

Toggle Snap Switch

Harvey Hubbell, Inc., of Bridgeport, Conn., has brought out a toggle surface switch which differs from the ordinary snap surface switch in that manipulation is by the throw of a lever or toggle, instead of by the turning of a key or button. Throwing the lever

SWITCH IS SELF-INDICATING.

up makes the circuit; throwing it down breaks the circuit. The advantages claimed for the toggle movement in a surface switch are, first, that it permits making the switch more attractive and stronger than the ordinary switch; second, manipulation is much more convenient by means of the lever than by the turning of a key; third, the switch is self-indicating, the position of the lever showing at a glance whether the current is "on" or "off" without any marker or dial. This switch conforms with the National Electrical Code standard requirements.

Plug Receptacle

The Gordon Electrical & Manufacturing Company, 430 South Green Street, Chicago, recently placed upon the market its No. 1708 Edison screw-plug flush receptacle. All plugs are made of solid brass in accordance with the requirements of the Underwriters' Laboratories, Inc., which has thoroughly approved the receptacle. The product is a slight departure from the ordinary receptacle in that the terminals and contact pieces together with brass-plated brackets at each end are used.

Automatic Controller or Rotary Switch

The accompanying illustration shows an automatic controller constructed by the Reynolds Electric Company of Chicago and New York for a fire-alarm siren made by the Federal Sign System (Electric) of Chicago. By an ingenious arrangement of contacts the sounds from the siren are graduated in

FOR A FIRE-ALARM SIREN.

tones ranging from low to shrill, and by means of suitable gearing the blowing, after continuing for a period of two minutes, is automatically cut off. To start the controller the mere pressing of a push-button switch suffices. This closes the circuit and starts the motor driving the controller, another switch on the controller opening the motor circuit after two minutes' operation, thus making practically an automatic device.

The motor is directly geared to the controller to insure a positive drive. The fingers are reinforced at the contact end and are of the "quick-break" type, and a holder provides for 1-in. (2.54-cm.) take-up in case of wear. The contacts are removable and adjustable.

Similar controllers are now being furnished by the Reynolds Electric Company to the city of Chicago for flashing "stop" signals, gate lights and ringing gongs when a drawbridge is open and the gates are down, giving a positive alarm both by light and sound.

Externally Operated Switches

The Trumbull Electric Manufacturing Company of Plainville, Conn., has developed several externally operated switches, one of which is shown herewith. In the fusible-top type the cover

FUSIBLE-BOTTOM TYPE OF SWITCH

prevents the switch from being connected until the box is closed, and in the fusible-bottom type the catch at the side prevents the switch from being connected until the box is closed. It is pointed out that the box cannot be opened when the switch is in contact and that it can be locked and sealed when the switch is in open position. The switches are of the quick-break type.

Motor-Generator Sets

Unit-type motor-generator sets for battery-charging and signal work are being made by the Electric Specialty Company of Stamford, Conn. These motor-generator sets are for charging storage batteries, operating electromagnets, bells or any form of signals. They are constructed to operate on 110 volts or 220 volts direct or alternating current. The smallest size delivers 20 watts and is intended for use only where a very small amount of power is required. Other types are suitable for charging one 6-volt battery at 8 amp. and 12-amp. respectively. The largest size, rated at 300 watts, will charge five 6-volt batteries at 10 amp. charge, tapering down to 8 amp. One type of set is furnished with oil-wick bearings and the other with oil-ring bearings. Motor-generators of more than 100 watts capacity only are regularly furnished with rheostats.

Light for Shaving

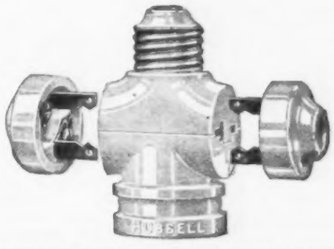
An electric light attachment to be used with a safety razor has recently been developed and is shown herewith. The outfit is complete with razor, trench mirror, strop handle and extra blades. The "Shavelight" attachment can also be used to advantage with a pencil or a fountain pen. The battery is of standard size and said to last for more than 100 shaves. The whole outfit is contained in a handsome khaki case. The Shavelight Corporation of 30 Church Street, New York City, is the manufacturer.

Pulley-Driven Propeller Fans

Pulley-driven propeller fans are one of the latest additions to the ventilating-fan equipment of the Batterman Truitt Company of Chicago. These fans are equipped with split-hub-type pulleys, the pulley being overhung on the fan shaft. This construction, it is pointed out, allows the removal or replacing of the belt at will and without necessitating the loosening of bearings and dismantling the fan frame. These fans are of two-bearing-type construction, having one bearing on each side of the fan wheel. These bearings are mounted in a retaining housing and are rigidly set in this housing with adjustable set-screws, thus allowing for their removal for inspection purposes. The bearings are of the split-bearing, ring-oiling, ball and socket type. These fans are made in diameters from 18 in. to 60 in. (45.7 cm. to 152.4 cm.).

Double-Outlet Current Tap

Harvey Hubbell, Inc., of Bridgeport, Conn., is supplementing its standard-single-outlet current tap with a new one providing two plug outlets in addition to the lamp outlet. This tap is to be known as No. 6553. This de-



TWO PLUG OUTLETS PROVIDED IN ADDITION TO LAMP OUTLET.

vice is constructed throughout of porcelain and is fitted with a shade-holder groove and slots so designed as to accommodate any one of this company's different styles of interchangeable plug caps.

Trade Notes

RATHBONE, SARD & COMPANY of Chicago are establishing wholesale offices and warehouses to handle their business in the Pacific Northwest.

THE WESTERN SERVICE COMPANY, Spencer, Iowa, has been organized for the purpose of engaging in civil and electrical engineering and power-plant efficiency practice.

THE PITTSBURGH ELECTRICAL SPECIALTIES COMPANY has moved from Pittsburgh to New York City, with offices at 396-398 Broadway. The factory is at 451 Greenwich Street.

GEORGE A. SCHNEIDER will succeed J. W. Tabb as manager of the Western Electric Company's branch at Buffalo, N. Y. George Seiss has been made assistant manager of the Cleveland office.

R. H. BALFOUR, sales manager of the Eugene F. Phillips Electrical Works, Ltd., Montreal, Canada, has been elected a director of the company. The capital of the company has been increased to $4,000,000.

F. V. GENTT, manager of the Louisville (Ky.) branch of the General Electric Company, has gone to Cincinnati, Ohio, where he will have charge of the central station and electric railway sections of the company.

J. C. MANCHESTER is now district sales manager for the Economy Fuse & Manufacturing Company, San Francisco. Mr. Manchester was formerly connected with the Interstate Electric Novelty Company in that city.

THE ESTERLINE COMPANY of Indianapolis, Ind., announces the appointment of J. S. Pandiani, Via Mario Pagano, 27, Milan, Italy, as trade representative for that country. Mr. Pandiani was until recently manager of the meter and supply department of the Italian Westinghouse Company and will in the future give his attention to the sale of Esterline instruments and permanent magnets throughout Italy.

McDONNELL & COMPANY of San Francisco, Cal., are distributing a circular dealing with the Poulsen Wireless Corporation. The patent originally introduced in this country from Denmark has been amplified by L. F. Fuller. The system has been adopted by the United States government at Cavite, Philippine Islands, for a plant nearing completion. The French government has closed a contract with the corporation for what is described as the most powerful wireless installation in the world.

THE GUARANTY TRUST COMPANY of New York City has compiled a complete list of holidays of all nations in a booklet of 145 pages. The reader may determine in a moment whether any day of the year is a holiday anywhere in the world; or, if the question is approached from the opposite side, what days in the year are celebrated as holidays by any particular country. It is designed for the use of manufacturers, jobbers, etc., doing an international business. Its compilation was made necessary by the new position of world leadership taken by American business men. A knowledge of what days are closed to business in any given country is highly important in carrying on international trade.

THE PHILADELPHIA STORAGE BATTERY COMPANY of Philadelphia has secured the services of G. L. Barrett as manager of the Southwestern division, and he will be found at 2605 Locust Street, in the Coliseum Building, St. Louis. Mr. Barrett was formerly president and general manager of the Willard Storage Battery Company of Texas, and has been in Texas for two and a half years handling the Southwestern distribution of the Willard storage batteries. Previous to that he was connected with the Willard company at Indianapolis and Cleveland, working in the starting, lighting and vehicle field. For six years previous to this he was in the automobile business in Minneapolis, Minn., in both gas and electric lines.

FORD, BACON & DAVIS announce the formation of the Ford, Bacon & Davis Corporation, organized for the purpose of conducting a general contracting business, with particular reference to industrial, public utility and power plants, steam and street railroads, docks, steamship and railway terminal facilities, subways, tunnels, hydroelectric and irrigation projects. In effect this means the continuance in corporate form of construction work which heretofore has been handled by the firm direct. The corporation's headquarters are at 115 Broadway, New York, with offices at New Orleans and San Francisco. The facilities from the firm of Ford, Bacon & Davis, now in its twenty-fourth year, which continues as heretofore, are available to the new corporation.

THE DRIVER-HARRIS COMPANY of Harrison, N. J., has announced an additional benefit accruing to its employees in the nature of paid-up life insurance. On Jan. 1 there was distributed to all employees who had been with the company at least six months on that date a life insurance policy for $500. It is the intention of the company to make a further distribution of these policies as other employees reach the six months' service period. The extra wage distribution this year was increased by 1 per cent over what has been paid heretofore. This distribution is based on salaries earned and terms of service and is distributed twice yearly. The percentage is graduated, beginning at 6 per cent to employees who have been with the company six months and increasing one-half of 1 per cent for each succeeding year of continuous service. The Jan. 1 distribution amounted to about $15,000. The fourth annual dinner of the company was held at the Downtown Club, Newark, N. J., Dec. 28, and was a very enjoyable affair.

THE NATIONAL BANK OF COMMERCE of New York City has compiled interesting statistics and information on the trade between the United States and New Zealand. The changes in trade routes occasioned by the war have greatly favored the export business of the United States. The bank has issued this statement which discusses the development of trade from the beginning of 1915 until the present: "In the field of electrical machinery the United States is gaining. In 1915 it supplied approximately one-fifth of all the electrical machinery which was imported into New Zealand, and in 1916 supplied one-fourth. It has met the Japanese as competitors in electrical supplies, but Japanese articles have apparently been found unsatisfactory. There is a great trade in New Zealand in electric torches and batteries. Americans lead the market, and for similar articles the American product is much cheaper. American batteries are also accompanied by a guarantee of service. Japan has delivered a great number of torches and batteries, but they are not satisfactory."

Trade Publications

PLIERS.—"Rimco" rubber-insulated pliers are illustrated and described in a leaflet prepared by the Rubber Insulated Metals Corporation of Plainfield, N. J.

LAMPS.—The Westinghouse Lamp Company of New York City has prepared a folder showing the growth of its plants caused by the increase in demand for its lamps.

SWITCHES AND PANELBOARDS.—The Leonard-Bundy Electric Company of Cleveland, Ohio, is distributing its bulletin E, descriptive of safety-type knife switches and panelboards.

FANS.—The Batterman Truitt Company of Chicago has prepared bulletin No. 43, descriptive of its pulley-driven propeller fans. This company has also issued its bulletin No. 44, giving information on its "Autovent" louvers.

REAMERS.—The Taft Pierce Manufacturing Company of Woonsocket, R. I., is distributing its bulletin No. 101, descriptive of the Martell system of line reaming bearings. Special applications of the Martell reamer are outlined.

FUSES.—The Trico Fuse & Manufacturing Company of Milwaukee, Wis., has prepared a leaflet descriptive of its renewable cartridge fuses. Seventeen features of these fuses are pointed out in this leaflet. This company has also printed a leaflet giving list prices of the fuses.

CHAIN DRIVES.—"The Ideal Drive for Rubber Mill Machinery" is the title of book No. 299, which has been prepared by the Link-Belt Company of Chicago, Ill. Illustrations and reasons why the Link-Belt drive is the ideal drive for rubber mill machinery are given. The bushed joint of the Link-Belt silent chain is described, as are casings for silent chain drives.

LIGHTING AND POWER PLANTS.—The Main Electric Manufacturing Company of Pittsburgh, Pa., has issued its catalog No. 100, in which are described the Main electric lighting and power plants. Valuable technical data, the amount of energy used by various appliances and wiring information are included. This is a well prepared and illustrated catalog and should be in the hands of all interested in this subject.

ROOF CONSTRUCTION.—The Asbestos Protected Metal Company of Pittsburgh, Pa., has prepared its bulletin No. 59 on the subject of "Roof Construction for Factory Buildings." In this bulletin it is brought out that the gypsum roof made by this company not only meets all of the exacting requirements of an ideal roof construction, in a way that entirely overcomes practical and economic objections, but offers several distinctive advantages that cannot be obtained with any other type of roof. Illustrations of representative installations are given.

GAS METERS.—The Backarach Industrial Instrument Company of Pittsburgh, Pa., is distributing its catalog E, descriptive of its "Hydro" gas meters. A review of the various methods employed for measuring gases, such as impact and Pitot tubes, orifices, nozzles, Venturi tubes, etc., is given. It is pointed out that in each of these devices the differential pressure is the quantity to be measured, and then follows a description of the "Hydro" instrument which measures and records this differential pressure accurately. Applications of the Hydro volume meter to blast furnaces, by-product coke ovens, gas works, producer plants, etc., are given, as well as for measuring air for mine and building ventilation.

New Incorporations

THE MENAHGA (MINN.) ELECTRIC COMPANY has been incorporated with a capital stock of $10,000 by S. J. Zeeman and others.

THE ELECTRIC SERVICE COMPANY of Cedar Rapids, Iowa, has been chartered with a capital stock of $20,000 by C. E. Rowe and others.

THE ELECTRIC MANUFACTURING COMPANY of Cairo, Ill., has been incorporated with a capital stock of $550,000 by Henry Tideman, Charles M. Roos and James H. Galligan.

THE HOLLY (S. C.) HILL ELECTRIC SERVICE COMPANY has been incorporated by S. P. Wells, B. R. Bennett and R. G. Carson of Holly Hill. The company is capitalized at $10,000.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY of Buffalo, N. Y., has been incorporated with a capital stock of $10,000 by E. H. Letchworth, W. M. Wilkins and C. M. Baldy of Buffalo, N. Y.

THE STORAGE BATTERY REBUILDING COMPANY of Cleveland, Ohio, has been incorporated by Henry L. Beggs, Samuel L. Bowlus, Lawrence C. Meyer, Arthur W. Longbarger and Gilbert J. Spencer. The company is capitalized at $15,000.

THE HYDRAULIC ELECTRIC COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $50,000. The incorporators are: J. J. Hobbs, Randolph C. Shaw and A. W. Britton, all of New York, N. Y.

THE MONARCH STORAGE BATTERY COMPANY of Grand Rapids, Mich., has been incorporated by T. H. Lavier, H. B. Knowlson, H. G. Dykhouse and others. The company is capitalized at $20,000 and proposes to manufacture and deal in storage batteries.

THE WAYLAND (MICH.) ELECTRIC LIGHT & POWER COMPANY has been incorporated with a capital stock of $5,000 to furnish electricity for lamps, heaters and motors in Wayland. The incorporators are: L. B. Mason, E. O. Hanlon, A. E. Weaver and others.

THE RICHARDSON AUTO ELECTRIC CORPORATION, Charles Street and Lafayette Avenue, Baltimore, Md., has been incorporated by Donald R. Richardson, Frank Laurence Pollard and Carl C. Schmidt. The company is capitalized at $50,000 and proposes to manufacture and repair batteries.

THE BLESSING MANUFACTURING COMPANY of San Francisco, Cal., has been chartered with a capital stock of $20,000 by H. H. Traub, J. W. Lederman, E. D. Lederman, L. Van Orden and T. E. Pawlicki, all of San Francisco, Cal. The company proposes to manufacture tools and machinery for the development of power by gas, steam, electricity, etc.

THE I. H. SIMPSON HARDWARE COMPANY of New York County, N. Y., has been incorporated by I. H. Simpson, 410 West End Avenue; C. W. Simpson, 356 Fourth Avenue, New York City; L. Genn, 42 Montrose Avenue, Brooklyn. The company is capitalized at $50,000 and proposes to do a general contracting and electrical business and deal in plumbers' supplies.

New England States

RANGELEY, MAINE.—The electric plant of the Oquossoc Light & Power Company is nearly completed, and is expected to be ready to put in operation about Feb. 1. F. B. Colby is president and manager.

CAMBRIDGE, MASS.—Extensive improvements are contemplated by the Cambridge Electric Light Company, including the installation of a 12,500-kw. turbine, two 600-hp. boilers, ash-handling system and extension of switchboard. Welles E. Holmes is general manager.

GARDNER, MASS.—The Gardner Electric Light Company contemplates the installation of an additional 1500-kva. bank of transformers this spring. C. A. Ware is manager.

MANSFIELD, MASS.—Two 250-kva. Westinghouse transformers will soon be installed in the municipal electric-light plant to replace two 125-kw. transformers now in use. George W. Wood is manager.

NORTH ATTLEBORO, MASS.—The extension of the commercial lighting lines of the municipal electric-light plant into Adamsdale is under consideration; also the purchase of electricity from the Attleboro Steam & Electric Company. William Plattner is manager.

PITTSFIELD, MASS.—The Pittsfield Electric Company is planning to install a 2500-kw. General Electric turbo-generator and two 520-hp. Babcock & Wilcox boilers. W. A. Whittlesey is superintendent.

READING, MASS.—Extensions and improvements are being made to the municipal electric-light plant, including an addition to boiler room, a new 600-kw. General Electric turbine, Wheeler condenser, an additional boiler, new switchboard, and changing the plant from two to three phase system. Arthur G. Sias is manager.

WEST SPRINGFIELD, MASS.—The Gilbert & Barker Company, Church Street, has awarded a contract for construction of an addition to its power plant, 55 ft. x 95 ft., one story, to the H. Wales Lines Company, 134 State Street, Meriden, Conn.

HARTFORD, CONN.—Contract has been awarded to J. H. Crozier, 721 Main Street, Hartford, and plans filed by the Southern New England Telephone Company, 185 Pearl Street, for additions and alterations in its exchange building, to cost about $10,000.

Middle Atlantic States

BROOKLYN, N. Y.—The Transit Development Company, a subsidiary of the Brooklyn Rapid Transit Company, has awarded a contract to the Structural Concrete Company for the construction of an addition to its electric generating plant at Kent and Division Avenues, to cost approximately $500,000. The building will be 211 x 257 ft., six stories high.

FREDONIA, N. Y.—The city of Fredonia has entered into a contract with the Niagara & Erie Power Company of Buffalo for furnishing electricity for lighting the streets, parks and public buildings in Fredonia for a period of five years. The municipal electric light plant will be closed down.

GOWANDA, N. Y.—The construction of a new electric power plant is reported to be under consideration by the Gowanda Light & Power Company.

LONG ISLAND CITY, N. Y.—The power plant of the New York & Queens Electric Light & Power Company on Mills Street was recently damaged by fire, causing a damage of about $15,000.

NEW YORK, N. Y.—Bids will be received by the State Hospital Commission Capitol, Albany, N. Y., until Jan. 29, for installation of an electric-lighting system consisting of underground feeder, poles, etc., for incandescent lamps, at the Manhattan State Hospital, Ward's Island. T. F. Pilcher is State architect.

ANDOVER, N. J.—Due to the scarcity of both coal and water, the Andover Electric Company, which has had dual power, has issued notification that it has been compelled to suspend operations temporarily.

EAST ORANGE, N. J.—The City Council in its annual budget for 1918, has provided for an appropriation of $52,500 for street-lighting purposes. The requisition has been approved.

EDGEWATER, N. J.—Plans have been filed by Spencer Kellogg & Sons for the construction of an addition to its power house, about 50 ft. by 50 ft., one story, at its plant. Contract has been awarded to the John W. Ferguson Company, 152 Market Street, Paterson.

JERSEY CITY, N. J.—Contract has been awarded by the Erie Railroad Company to F. A. Knapp, Jersey City, for the construction of a galvanized iron boiler house at its yards at the foot of Pavonia Avenue.

KEARNEY, N. J.—Plans have been filed by the Federal Shipbuilding Company for the erection of a large power house and boiler shop at its works, to cost $60,000 and $170,000, respectively.

MATAWAN, N. J.—The installation of electrically operated pumping machinery in the municipal water-works system is under consideration by the Borough Council.

NEWARK, N. J.—The lowest bid submitted to the Board of Freeholders for the installation of electric-lighting and power wiring in the laundry building at the County Hospital at Overbrook, was submitted by the Beyer Engineering Company of Newark, at $14,174.

TOMS RIVER, N. J.—The Board of Public Utility Commissioners has granted the Toms River Electric Company permission to issue $15,000 in capital stock, the proceeds to be used for extensions, improvements, etc.

TRENTON, N. J.—Work has begun on placing of foundations for the new 2000-hp. engine and generator to be installed in the plant of the Trenton & Mercer County Traction Corporation, for which orders have already been placed. The company is making extensive improvements throughout its entire plant and has also commenced the reconstruction of the portion of its car-barns recently destroyed by fire.

BRIDGEPORT, PA.—Plans have been filed by the Philadelphia & Reading Railway Company, Reading Terminal, Philadelphia, for the erection of an addition to its local power house, about 95 ft. x 100 ft. Contract for the building has been awarded.

CLIFTON HEIGHTS, PA.—Plans are being prepared for interior alterations to the local electric plant to provide for the installation of power equipment. Frank E. Hahn is architect.

COATESVILLE, PA.—The Chester Valley Electric Company is erecting a new electric transmission line from its station at Phoenixville into Coatesville, a distance of about 18 miles, to supply electricity to the plants of the Midvale and Lukens Steel companies in Coatesville.

HARRISBURG, PA.—Extensive improvements are contemplated by the Harrisburg Light & Power Company in its steam heating plant. C. M. Kaltwasser is manager.

NEW BOSTON, PA.—Plans are being considered by the New Boston Coal Land Company for equipping its Morea mine for electrical operation throughout.

NORRISTOWN, PA.—The Counties Gas & Electric Company has filed notice with the Public Service Commission of an issue of bonds to the amount of $300,000 for extensions, improvements, etc., to its system.

PITTSBURGH, PA.—A permit has been granted to the National Biscuit Company for the erection of bakery, power plant, garage and stables at Penn Avenue and Lambert Street. The total cost is estimated at $550,000.

PITTSBURGH, PA.—Application has been made by the Allegheny County Steam Heating Company of Pittsburgh for permission to lease a portion of the Allegheny County Prison, which will be utilized as an auxiliary to its present plant.

WILLIAMSPORT, PA.—Extensive improvements are contemplated by the Lycoming Edison Company to its plant and system during 1918. Arrangements are now being made for an appropriation of about $250,000 for the proposed work.

BALTIMORE, MD.—Plans have been filed by the Bartlett Hayward Company, Scott and McHenry Streets, for the erection of a new transformer station at Hamburg and Gunpowder Streets. Contract for building has been awarded to Morrow Brothers, Fidelity Building, Baltimore.

CUMBERLAND, MD.—The Cumberland Electric Railway Company is planning to construct an extension to the plant of the Kelly-Springfield Tire Company and to the new Ridgedale addition and also double-tracking on Green and Water Streets.

PRINCESS ANNE, MD.—E. C. Cannon, owner of the local electric-light plant, expects to establish a 24-hour service April 1, unless prevented by war conditions.

CHARLESTON, W. VA.—The Charleston-Dunbar Traction Company expects to place in service 9 miles of track between Dunbar and Poca during 1918.

DUNGANNON, VA.—Plans are being considered by Charles F. Hagan, trustee of Patrick Hagan Estate, Bristol, Va., for the construction of a hydroelectric power plant on Cinch River, near Dungannon.

GLEN LYN, VA.—Plans have been completed by the Appalachian Power Company of Bluefield for the construction of a steam-driven electric generating plant on New River providing for an ultimate development of 75,000 kw. The power house and equipment will cost about $2,000,000. The initial installation will have a generating capacity of 16,750 kw. The water intake, etc., will provide for ultimate capacity. Contracts for equipment, including turbine, boilers, transformers, condensers, pumps, automatic stokers, switchboard, coal-handling machinery, etc., have been awarded. Viele, Blackwell & Buck, 49 Wall Street, New York, N. Y., are designing and constructing engineers.

RICHMOND, VA.—Plans have been prepared and application filed for permit by the Virginia Railway & Power Company for an addition to its power plant at the foot of Twelfth Street, to cost about $6,000.

SUFFOLK, VA.—The Virginia Railway & Power Company, it is reported, will erect an electric transmission line from Petersburg to Suffolk.

THE PLAINS, VA.—The Plains Electric Light Company, it is reported, is planning to rebuild its electric-light and power plant, recently destroyed by fire.

WYTHEVILLE, VA.—R. P. Johnson, First National Bank Building, Wytheville, it is reported, would like to receive prices on a 200-kw. (Westinghouse preferred) direct-current, 250-volt, 800 amp., 200 r.p.m. generator, second hand, in good condition.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Various, Schedule 1653—30 motor-generator sets. Philadelphia, Pa., Schedule 1652—one mill type tractor. Application for proposal blanks should designate the schedule desired by number.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 1 for the installation, complete, of an elevator in the United States post office and court house extension at Oklahoma City, Okla., and in the United States court house, etc. (remodeling), at Austin, Tex. Drawings and specifications may be obtained at the above office.

WASHINGTON, D. C.—Bids will be received at the general engineer depot, 1438 U Street Northwest, Washington, D. C., until Jan. 21, for furnishing (under circular 513) the following supplies: 1600 lightning arresters, 1600 extra gapments, 1600 lightning arresters, 8000 guy anchors, 160,000 cross-arm braces, 480,000 short malleable brackets, 160,000 oak brackets, 1600 tool belts, 3,200,000 porcelain cleats, 80,000 cut-outs, 80,000 cutouts, 16,000 guy clamps, 1600 splicing clamps, 160,000 cable connectors, 160,000 cable connectors, 648,000 plug type fuses, 156,000 inclosed fuses, 72,000 inclosed fuses, 3200 lb. fuse wire, 1600 fuse boxes, 4000 link fuses, 8000 link fuses, 4000 wire grips, 400 lineman's slack tackle, 3200 enameled hoods, 1600 hatchets, 2200 handles, 800,000 brass insulators, 32,000 porcelain insulators, 24,000 porcelain knobs, 480,000 insulator pins, 555 kerosene fire pots, 555 melting pots, 80,000 connecting plugs, 480,000 pendent cap rosettes, 480,000 reflectors, 800 wire reels, 1600 reducers, 1600 reducers, 240,000 brass sockets, 200 000 brass sockets, 40,000 cleat base sockets, 160,000 rotary switches, 24,000 knife switches, 12,000 knife switches, 1600 safety straps, 769,600 porcelain tubes, 400,000 lb. black friction tape, 9600 copper terminals, 4800 cable taps, 32,000 cable taps and 400 tube cutters. For further information address the above office.

North Central States

BELLAIRE, MICH.—The city of Charlevoix has entered into a 10-year lease with the Hydraulic Power & Light Company for all power generated by the company, with an option to buy the plant, which will be submitted to the voters in the spring. The installation of a 350-hp. vertical hydroelectric generating unit this spring is under consideration by the city of Charlevoix. Henry Richardi is president and treasurer.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

BENTON HARBOR, MICH.—The Benton Harbor-St. Joe Railway & Light Company is changing its system from 2300-volt delta to 4000-volt Y. John A. Cavanaugh is superintendent.

BOYNE CITY, MICH.—The Boyne City Electric Company will add 10 incandescent street lamps as soon as the weather will permit. Extensions and additions to the domestic service will require rearrangement and addition to transformer outfit in the spring. Charles T. McCutcheon is superintendent.

CHARLEVOIX, MICH. — The city of Charlevoix has entered into a contract with the Hydraulic Power & Light Company for a lease of all power generated by the company for a period of ten years, with an option to buy. The proposal will be submitted to the voters in the spring.

COLDWATER, MICH.—The Board of Public Works is contemplating the installation of a 750-kw. turbo-generator set, barometric condenser, centrifugal circulating pump, flywheel air pump, feed water heater, etc., in the municipal electric-light and water works plant. L. E. McQueen is superintendent.

HOWELL, MICH.—The Board of Public Works contemplates improvements to the electric-light plant, including the erection of a new smokestack and installation of water equipment.

JONESVILLE, MICH.—The Board of Public Works contemplates the installation of a motor-driven centrifugal pump (200 gal per minute), motor 20 hp., 440 volts, three-phase, 60 cycles, to replace one of two steam fire pumps now in use. R. S. Newton is superintendent.

LAWTON, MICH.—Plans are being considered for changes in the pumping equipment of the municipal electric-light and water-works plant in the near future. As yet nothing definite has been decided upon. R. W. Brown is engineer power station.

MARSHALL, MICH.—The Board of Electric Light and Water Commissioners is considering some changes at the municipal electric-light plant, which will increase the efficiency of the waterwheel equipment. Details have not yet been worked out. P. S. Joy is superintendent.

MILFORD, MICH.—The Milford Electric Company is installing another 30-hp. water wheel on Pettibone Creek in Milford and will operate a motor in connection with generator. F. S. Hubbell is proprietor.

OVID, MICH.—The village of Ovid will soon purchase two 250-hp. water-tube boilers and electrically-driven pumps. Fred G. Davis is superintendent.

PETOSKEY, MICH.—Improvements are being made to the municipal electric-light plant, including the installation of two 75-kw. umbrella type generators, directly connected to waterwheels located at the municipal water-works plant further down the river; water is conveyed from the upper plant in a cement tube to this point. The discontinuance of the direct-current service is contemplated upon the completion of the new plant. J. E. Niles is city clerk and purchasing agent.

PORTLAND, MICH.—The Board of Public Works is planning to install an ornamental lighting system next April and May, consisting of 42 single-lamp posts. G. A. Knox is president of board.

ST. CHARLES, MICH.—The Board of Public Works is planning to install a new series street-lighting system in the spring. David G. Howey is superintendent.

STURGIS, MICH.—The Board of Public Works contemplates the installation of a 500-kw. auxiliary generating unit, either oil or steam, during the coming year. J. S. Flanders is manager.

CINCINNATI, OHIO.—The City Council has granted the Cincinnati, Lawrenceburg & Aurora Electric Street Railroad Company a franchise to construct a street railway from Cincinnati to Anderson Ferry.

CLEVELAND, OHIO.—The Willard Storage Battery Company, it is reported, contemplates the construction of an addition to its plant, 100 ft. by 135 ft. Bids for the work, it is understood, will soon be asked for.

CLEVELAND, OHIO. — Improvements are contemplated to the municipal electric-light plant, involving an expenditure of about $700,000. The proposed work will include the installation of switchboard, generator, boilers and engines.

CLEVELAND, OHIO.—Bids will be received at the office of commissioner of purchases and supplies, City Hall, Cleveland, Ohio, until Jan. 25, for coal storage bunker for the division of light and heat. Specifications may be obtained at the office of division of light and heat.

PENINSULA, OHIO.—The Moody & Thomas Milling Company is reported to be considering the construction of a new electric power plant, to replace the one recently destroyed by fire.

GUTHRIE, KY.—The South Kentucky Power Company contemplates erecting an electric transmission line to Lebanon, Tenn., to furnish electrical service in Watertown and Alexandria. The company has a plant in Watertown which supplies electricity there and in Alexandria.

MAYSVILLE, KY.—The new steam turbo-generating plant of the Maysville Power Company will be finished and put in operation in about two months. When completed the plant will furnish electricity for the entire systems of the Maysville Gas Company and the Maysville Street Railroad & Transfer Company. The present power plant of the Maysville Gas Company will be held intact for use in emergencies. Horace J. Cochran is president and manager of the Maysville Gas Company.

WALTON, KY.—The Walton Electric Light Company contemplates the purchase of a generator to be directly connected to engine, already installed; also to erect a 10,000-gal. oil storage tank. E. L. Kelly is owner and manager.

WILLIAMSBURG, KY.—The Williamsburg Electric Light Company is contemplating establishing a 24-hour service. H. L. Bryant is secretary and general manager.

CRAWFORDSVILLE, IND.—The Crawfordsville Electric Light & Power Company (municipal) is installing a 350-hp. Stirling boiler. F. H. Miller is manager.

HAGERSTOWN, IND.—The new City Council, it is understood, will take action in establishing a 19-hour or 24-hour service soon after taking oath of office. The municipal electric light department will be in the market for a new engine and generator, directly connected, at an early date; the engine will be of the fuel-oil type, with rating from 125 hp. to 200 hp.; generator will be 220-volt, two-wire, complete with switchboard. R. G. King is manager.

LA GRANGE, IND.—The La Grange County Light & Power Company is contemplating the installation of a new 400-hp. Fitchburg engine and changing the plant from 133 cycles, single phase, to 60 cycles, three phase, next summer. L. G. Young is superintendent.

BELLEVILLE, ILL.—The St. Clair County Gas & Electric Company is trying an experiment in the use of natural gas to replace coal. Should the tests prove successful the company will ask the Illinois Public Utilities Commission for permission to make the necessary changes in its plant.

BLOOMINGTON, ILL.—A 600-kva. turbo-generator set will be installed in the municipal electric-light plant as soon as conditions become normal. C. C. Williams is superintendent.

CHICAGO, ILL.—The capital stock of the Midland Electric Steel Company has been increased from $40,000 to $100,000.

CHICAGO, ILL.—The Lincoln Park Commissioners contemplate the installation of a 500-kw., three-phase, 2300-4000-volt turbo-generator for heating system; also 300 additional 400-cp. type C park lamps, on concrete poles, and arranging all multiple circuits to regulated type. Claude H. Shepherd is electrical engineer.

ELBURN, ILL.—Preparations are being made to install a Westinghouse 50-kva., single-phase, 60-cycle, 1100-volt generator in the municipal electric-light plant. Machinery has already been purchased. A. S. Sharp is superintendent.

FISHER, ILL.—The construction of a new electric plant changing from steam to oil equipment is under consideration by the Town Board. Nothing definite has been decided upon. A. L. Baker is engineer.

GOLCONDA, ILL.—The Golconda Light & Water Company contemplates the installation of a 25-kw., three-phase, 2300-volt generating unit, directly connected. Nothing definite has yet been decided on. R. H. Williamson is secretary and manager.

GRAYVILLE, ILL.—The Electric Light Commissioners are installing an ornamental street-lighting system, consisting of 11 ornamental standards mounted with one 100-cp. and four 80-cp. lamps. C. Richards is superintendent.

LA SALLE, ILL.—Plans are now being prepared for the installation of a 250-hp. engine to operate arc machines. E. Byrne is city engineer.

MILLSTADT, ILL.—Preparations are being made to install a Chuse non-releasing Corliss engine, directly connected to a 72-kw. generator and an 80-hp. boiler, at the municipal electric-light plant. E. W. Marxer is Mayor.

PENDLETON, ILL.—Work is nearly completed on the erection of 3 miles of electric transmission lines into the country. Alva Apple is superintendent of the municipal electric-light plant.

PERU, ILL.—Improvements to the municipal electric-light plant, consisting of the installation of a 200-hp. American Stumpf uniflow engine, directly connected to a 150-kva. General Electric three-phase, 60-cycle, 2300-volt generator and mechanical draft system, will be completed about Feb. 1. J. H. Haim is superintendent.

SAVANNA, ILL.—The installation of a 625-kva. turbine is under consideration by the People's Gas & Electric Company. F. P. Bowen is manager.

STAUNTON, ILL.—The car barns and repair shops of the Illinois Traction System were recently destroyed by fire, causing a loss of about $35,000.

STRONGHURST, ILL.—The new electric plant of M. F. T. Schierbaum was put into operation Jan. 5. The equipment consists of a 75-kw., single-phase, 60-cycle Royal Electric generator, with exciter; a 75-hp. Frost engine and an 80-hp. Frost boiler. The old plant was destroyed by fire on Nov. 10, 1917.

WINNETKA, ILL.—The installation of a Manistee Roturbo condenser in the municipal electric-light plant is under consideration. H. L. Woolhiser is manager.

MADISON, WIS.—Plans are being prepared for the erection of a substation on Sprague Street for the city. E. E. Parker is city engineer.

SHEBOYGAN, WIS.—Plans are being prepared by Juul & Sixta of Sheboygan, architects, for an addition to the power house of the Badger State Tanning Company.

BLOOMINGTON, MINN.—Contract has been awarded for electric wiring of the Consolidated School Building to the Sterling Electric Company, 33 South Fifth Street, Minneapolis, at $2,773.

VIRGINIA, MINN.—C. E. Nystrom, architect, has been authorized to advertise for bids for electrical work for the new school building. The cost is estimated at about $10,000.

ALGONA, IOWA.—New equipment is being installed in the municipal electric-light plant, consisting of a 200-hp. oil engine and a 170-kva. General Electric generator. When completed the system will be changed from 1150 volts to 2300 volts. J. W. Kelly is superintendent.

BLOOMFIELD, IOWA.—Two new electric generators, one 225-kw. and one 75-kw. alternating current, will be installed in the municipal electric-light plant this year. Improvements, including the installation of two 150-hp. boilers and erection of brick smokestack, were made to the plant during 1917, at a cost of about $8,000. T. Z. Millard is general superintendent.

CEDAR RAPIDS, IOWA.—Extensions are contemplated by the Iowa Telephone Company, including the installation of approximately 30 blocks of conduits, tile, etc., and improvements to telephone exchange, to cost about $40,000. J. M. Rider, 319 South Second Street is manager.

CORYDON, IOWA.—The installation of a new generator in the municipal electric-light plant is under consideration by the electric light committee. A. T. Gallagher, is clerk.

DES MOINES, IOWA.—Plans have been prepared, it is reported, by the Inter-Urban Railway Company for the construction of a four-story terminal station in Des Moines, to cost about $200,000.

EMMETSBURG, IOWA.—The Northern Iowa Gas & Electric Company contemplates extending its electric transmission line to Dickens.

ST. ANSGAR, IOWA.—The Light & Power Company of St. Ansgar is contemplating the development of a new water power this year. O. H. Koch is secretary.

PLATTSBURG, MO.—The Clinton County Telephone Company contemplates improvements to its system, to cost about $15,000.

LESTERVILLE, S. D.—The proposal submitted by Otto S. Oleson for the installation of an electric-lighting system in Lesterville, to cost about $8,000, has been accepted by the Town Board.

BANCROFT, NEB.—Bids will be received until Jan. 31 for construction of a complete electric system, water-works extensions and municipal building, to cost approximately $39,700. The Electrical Development, Frances Building, Sioux City, Iowa, is engineer.

TECUMSEH, NEB.—The City Council is considering the purchase of an engine for the water-works plant.

OAKLEY, KAN.—Plans are being considered for the installation of a new generating unit in the municipal electric-light plant, consisting of (probably) 150 to 175

hp. to replace the present engine. Not yet definitely decided upon; also for a new well and motor. Grant Maurer & Son are engineers. W. B. Day is superintendent.

KINSLEY, KAN.—The Kinsley Electric Light & Power Company is erecting an electric transmission line (a total of 30 miles) to Garfield. A. L. Moe is owner and manager.

SABETHA, KAN.—The City Council is planning to change equipment of the municipal electric-light plant from single to three phase system. C. A. Darby is city engineer.

STOCKTON, KAN.—New equipment, including one 200-hp. Fairbanks-Morse engine (oil burning) and a 170-kva. generator, directly connected, is now being installed in the municipal electric plant. F. A. Chipman is city clerk and purchasing agent.

WELLINGTON, KAN.—The city of Wellington contemplates purchasing 100 water meters to complete metering all service. Specifications have been completed for the immediate construction of a 500,000-gal. reservoir, five new wells and installation of five low-pressure pumps, necessary piping and electrical equipment. J. R. Murphy is superintendent of public utilities.

WILSON, KAN.—Plans are being prepared by A. A. Potter, dean of engineering department, State Agricultural College, Manhattan, for extensions to the municipal electric-light plant, to consist of the installation of one 150-hp. uniflow engine directly connected to three-phase, 2300-volt generator, together with two 80-hp. horizontal return tubular boilers. J. H. Williams is superintendent.

Southern States

ABBEVILLE, S. C.—The Abbeville Cotton Mills, it is reported, will receive bids for electric wiring of 100 cottages.

LOCKHART, S. C.—Plans are being prepared for the construction of a hydroelectric power plant for the Lockhart Power Company, a subsidiary of Monarch Mills. Emslie Nicholson of Union, S. C., is treasurer of Monarch Mills.

AMERICUS, GA.—Owing to an increased price for street-lighting service under a proposed new contract with the Americus Lighting Company, steps have been taken to establish a municipal electric-lighting plant in Americus. The contract for street-lighting will soon expire.

ATLANTA, GA.—With a view of improving the street car line service from Buckhead to Camp Gordon, the Georgia Railway & Power Company proposes to double-track the railway to a point near the intersection of Piedmont Road and Peachtree Road.

ATLANTA, GA.—The Doss Rubber Company contemplates the construction of a plant to manufacture inner tubes, which will be equipped for electrical operation. The company, it is reported, is in the market for motor-driven calenders and miscellaneous motor-driven machinery.

ATLANTA, GA.—Arrangements have been made by the Southern Railway Company to secure energy from the Georgia Railway & Light Company of Atlanta to operate its Inman yards shops. Electricity will be used for a signal system, air compressors, round house and lighting the yard.

BLAKELY, GA.—A two-story cold storage warehouse is being erected to be operated in connection with the municipal ice plant. E. R. Adams is superintendent.

COCHRAN, GA.—The town officials are considering extensions and improvements to the municipal electric-light plant and waterworks system, to cost about $5,000, this year. Nothing definite has been decided upon. C. W. Davis is superintendent.

CORNELIA, GA.—Preparations are being made by the Wofford Shoals Light & Power Company to furnish electrical service in Clarksville, consisting of twenty 100-watt street lamps and 50 meter customers. The company is also considering extending its transmission line to Lula, Ga., soon. J. A. Wells is secretary and treasurer.

ELBERTON, GA.—Improvements are being made to the municipal water and electric plant, including the installation of a 75-hp. centrifugal pump to replace the steam pumps. G. F. Cleveland is general superintendent.

KENNESAW, GA.—J. G. Lewis has contracted with the Georgia Railway & Power Company of Atlanta for electricity to operate the local system. An electric transmission line will be erected from Kennesaw to connect with the high-tension line of the company.

PORTLAND, GA.—The American Potash Company has contracted with the Georgia Railway & Power Company of Atlanta, to furnish energy to operate fuller mills for the extraction of potash for sericite. The contract calls for 200 kw.

WAYNESBORO, GA.—Improvements are contemplated to the municipal electric-light plant, including the installation of one 200-hp. boiler, one 100-kw., three-phase, 60-cycle, 2300-volt generating unit, directly connected, with switchboard complete. J. C. Andrews is superintendent.

ORLANDO, FLA.—The Orlando Water & Light Company is planning to install a 1000-kw. General Electric turbine this summer. Donald A. Cheney is general manager.

PRESSMEN'S HOME, TENN.—The Clinch River Hydro-Electric Company is building a hydroelectric plant on Richardson's Creek, near Clinch River, at a cost of about $60,000. The plans provide for a development of about 1000 hp. and the erection of 9 miles of electric transmission lines. All contracts for machinery have been awarded. John N. Adams of Charlestown, Tenn., is engineer George L. Berry is president.

FORT MORGAN, ALA.—Contract has been awarded by the War Department to Jett-Muths Construction Company of Mobile for the erection of nine cantonment buildings for coast artillery companies, including electric lighting, sanitary plumbing, drainage systems, etc.; also for building railroad extension to cantonment.

GENEVA, ALA.—Plans are being considered by the Geneva Power Manufacturing Company for the construction of a hydroelectric plant on Double Bridge Creek. As yet definite plans have not been decided upon.

TUSCALOOSA, ALA.—The Tuscaloosa Railway & Utilities Company is building an engine room, 60 ft. by 95 ft., and a car barn, 44 ft. by 167 ft. I. W. Ross is vice-president and general manager.

COLUMBUS, MISS.—The trustees of the Mississippi Industrial Institute and College are considering a bond issue for the erection of a power house and other buildings, to cost about $175,000. H. L. Whitfield is president.

FORT SMITH, ARK.—The Fort Smith Light & Traction Company has been awarded a contract for furnishing an ornamental lighting system on Garrison Avenue for a period of ten years. The contract calls for the installation of 74 lamps of 400 cp. mounted on steel poles.

OSCEOLA, ARK.—The town officials are contemplating the installation of a 200-kva. generatng unit in the municipal electric plant during the coming summer. Ed. Teaford is manager.

BLANCHARD, OKLA.—The City Council is considering the installation of an electric-lighting system.

DOVER, OKLA.—The installation of an electric-lighting system in Dover is reported to be under consideration by the City Council.

OKLAHOMA CITY, OKLA.—The International Cotton Picker Corporation, it is reported, is in the market for electric equipment for a cotton picker manufacturing plant. Fred W. Barnacio of Oklahoma City is manager.

WOODWARD, OKLA.—At an election held recently the proposal to issue $20,000 in bonds for the installation of a municipal electric-light plant was carried.

Pacific and Mountain States

PORT GAMBLE, WASH.—Preparations are being made by the Puget Mill Company for the installation of a 1000-kw. steam turbo-generator unit. Contract for machinery has been placed with the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. A. B. Pracna, of Seattle, is consulting engineer.

SEATTLE, WASH.—Plans are being prepared for the erection of a substation for the City Lighting Department at West Forty-ninth Street and Fourteenth Avenue, N. W. The building will be 66 ft. by 66 ft., one and two stories high, and will cost about $75,000. Daniel Huntington is city architect.

SEATTLE, WASH.—Work, it is understood, will soon begin on the construction of an electrically operated steel mill on Puget Sound, near Seattle by interests connected with the Alaska Gastineau Mining Company, to cost about $25,000,000, of which $9,000,000 will be expended on the initial installation. B. L. Thane, S. F. B. Morse, W. H. Crocker, of San Francisco, and others are interested.

SEATTLE, WASH.—D. F. Houston, Secretary of Agriculture, in a communication to the City Council, states that if the city of Seattle can give satisfactory assurances that it intends to and is in a financial position to make immediate development of the power site of the Skagit River in the Washington National Forest, about 100 miles from Seattle, the Department of Agriculture will give the city a permit to construct the plant. The maximum development is estimated at 200,000 kw. Although the present plans provided for in the $5,000,000 bond issue, authorized by the Council recently, directs that the Board of Public Works shall call for bids for a completed project in some national reserve, anticipating that bids would be received on the Diablo project, when the city would acquire the rights from the government, in the event no bids are received on the project, the Board of Public Works is given authority to construct the plant by day labor. The Diablo Canyon power project is located on the Skagit River. To reach it a transmission line about 135 miles will be needed. The City Council is also considering the Stillaguamish River power site offered to the city for $800,000 by the Skykomish Power Company.

PORTLAND, ORE.—The Northwestern Electric Company, Pittock Block, has awarded contracts for the immediate construction of an additional plant in Portland, which will increase its output by 50 per cent. Wilber E. Coman of Portland is vice-president and general manager.

BLACKFOOT, IDAHO.—The City Council is considering the installation of an ornamental lighting system.

REDSTONE, MONT.—Plans are being considered for rebuilding the local electric-lighting plant, including the installation of new machinery. S. J. Dorothy is reported interested.

CASPER, WYO.—The power plant of the Natrona County Electric Company was recently destroyed by fire, causing a loss of about $150,000.

ASPEN, COL.—The Roaring Fork Electric Light & Power Company is installing an additional generating unit, consisting of a 400-kw. General Electric, direct-current, 600-volt generator directly connected to a 700-hp. Pelton-Doble waterwheel. C. E. Doolittle is manager.

DENVER, COL.—The Denver Tramway Company is planning to equip the Gold Division from Gravel Spur, a distance of about 4 miles, for electrical operation, using the third-rail system.

Canada

FORT WILLIAM, ONT.—Tenders, it is reported, will be called for the construction of a tunnel under the Kaministiquia River for the purpose of carrying water mains, eelctric light, power and telephone cables. The cost is estimated at $150,000.

MONTROSE, ONT.—The Hydro-Electric Power Commission is building a railway from the Welland River, near Montrose, around Niagara Falls City to the Niagara River near Queenston, a distance of about 12 miles, in connection with the Chippewa-Queenston power canal. About 8 miles, it is reported, have been completed at the northern end of the line. F. A. Gaby, chief engineer of the commission, has charge of the work.

WIARTON, ONT.—Estimates are being prepared by the Hydro-Electric Power Commission of Ontario of the cost of the installation of an electric-light and power system in Wiarton.

LUMSDEN, SASK.—The purchase of the local electric-light plant, at a cost of $7,000, is under consideration by the Town Council.

Miscellaneous

PANAMA.—Bids will be received at the office of the purchasing officer, the Panama Canal, Washington, D. C., until Jan. 24 for furnishing (under circular 1193) the following supplies: steel, iron, wire, steel cable, oil-burning ranges, electric griddles, refrigerating apparatus, etc. For further information address A. L. Flint, general purchasing officer.

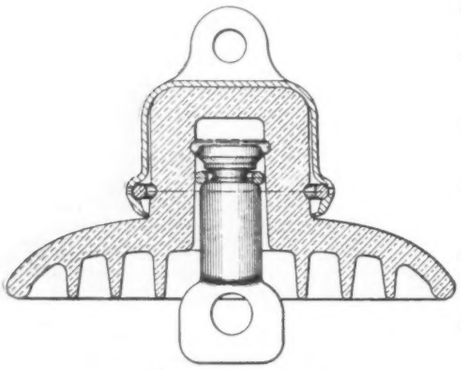
PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 2 for railroad track scale, pressure gages, marine clock, thermometers, steam traps, air compressor, tandem, link pins, cable clips, pipe fittings (black, galvanized and brass), steam cocks stop cocks, valves, etc. Blanks and information pertaining to this circular (1195) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y., Audubon Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

(Issued Dec. 25, 1917)

1,250,952. Trolley-Wire Hanger; Floyd G. Bovard, Mansfield, Ohio. App. filed July 31, 1916. More particularly for lines where catenary construction is used.

1,250,961. Telegraphy; William M. Bruce, Jr., Springfield, Ohio. App. filed Feb. 12, 1914. As applied to submarine cables or conductors of high capacity.

1,250,978. Method of Charging and Utilizing Storage Batteries; John H. Creveling, Auburn, N. Y. App. filed May 17, 1915. Improvements.



1,251,097—Strain Insulator

1,251,005. Electric Battery; Harry F. French, Fremont, Ohio. App. filed July 20, 1915. Arrangement for preventing upward displacement or bulging of the seal in a cell.

1,251,013. Insulator Joint; Walter T. Goddard, Hamilton, Ontario, Canada. App. filed April 4, 1916. Pin-supported type.

1,251,023. Automatic Telephone System; Harry E. Hershey, White Water, Kan. App. filed Nov. 28, 1913. Means employed for selecting an idle trunk.

1,251,037. Lightning-Protective Attachment for Oil Tanks and Other Structures; Francis B. Jackson, Tulsa, Okla. App. filed Aug. 5, 1915. Improvements.

1,251,060. Heater; Joseph A. Lesperance, Montreal, Quebec, Canada. App. filed June 8, 1916. Adapted to be inserted into a body of water for raising the temperature of the water.

1,251,097. Strain Insulator; John M. Peck, Victor, N. Y. App. filed Jan. 25, 1917. High tension.

1,251,116. Electric Boiler; Ora E. Sarr, Ceylon, Ohio. App. filed May 25, 1917. Means for suspending electrode plates within the boiler.

1,251,120. Switching Apparatus; William M. Scott, Tredyffrin Township, Chester County, Pa. App. filed April 8, 1915. Comprising a plurality of switches or circuit breakers.

1,251,126. High-Tension Rectifying Apparatus; Homer C. Snook, Oak Park, Ill. App. filed April 13, 1909. Switch.

1,251,159. Safety Switch; Richard Wolfsberg and Sidney C. Smith, Los Angeles, Cal. App. filed April 30, 1917. Fuses are stationary and are separate from the switch members proper.

1,251,165. Signal Device for Vehicles; Harry M. Addison, San Diego, Cal. App. filed Dec. 4, 1918. Improvements.

1,251,171. Secondary Clock; Lawrence O. Beard, Lancaster, Pa. App. filed Aug. 6, 1915. Electrically controlled escapement mechanism therefor.

1,251,178. Electric Switch; Charles W. Brockett, Brooklyn, N. Y. App. filed Jan. 18, 1916. Key socket.

1,251,181. Air-Brake System for Trucks; Elbert G. Chandler, Portland, Ore. App. filed Oct. 23, 1913. Unit air-brake mechanism or apparatus.

1,251,190. Indicating and Recording System; Amos F. Dixon, Newark, N. J. App. filed June 21, 1915. Remote-control type.

1,251,194. Lightning Arrester; Robert B. Dyer, Waurika, Okla. App. filed Jan. 4, 1917. Telephone.

1,251,208. Alternating-Current Telegraph and Telephone Duplex; John P. Ferriter, Jacksonville, Fla. App. filed Sept. 20, 1916. Provision of a junction coil of special construction.

1,251,210. Electrical Water Heater; Ida R. Forbes, Los Angeles, Cal. App. filed June 24, 1916. For douches.

Record of Electrical Patents

Notes on United States Patents

1,251,216. Impulse Starter; Eugene Gassmann, Brooklyn, N. Y. App. filed Jan. 26, 1917. Electrical ignition devices for internal-combustion engines.

1,251,217. Ignition Device for Internal-Combustion Engines; Eugene Gassmann, Brooklyn, N. Y. App. filed March 14, 1917. Improvements.

1,251,219. Telephone-Call-Charge System and Apparatus; Charles L. Goodrum, New York, N. Y. App. filed May 10, 1915. Automatic telephone systems.

1,251,224. Circuit Breaker; Carl K. Gustafson, Springfield, Mass. App. filed Dec. 3, 1913. Used in connection with an ignition system for a hydro-carbon engine.

1,251,249. Combined Timer, Distributer and Current-Reversing Device; Joseph H. Lehman, New York, N. Y. App. filed Jan. 18, 1915. Improvements.

1,251,269. Rectifier; Harry A. Mulvany and Harry E. Kennedy, Berkeley, Cal. App. filed Nov. 24, 1915. Plate type.

1,251,283. Illuminating Sign; George R. Pyer, Midvale, Utah. App. filed March 20, 1917. Sign is constructed with translucent portions which are illuminated from behind, members with rotating blades being mounted between the illuminating means and the translucent portions of the sign.

1,251,286. Controller for Power-Operated Devices; Thomas H. Rodman, New York, N. Y. App. filed March 3, 1911. For printing presses.

1,251,294. Switching Apparatus; William M. Scott, Tredffrin Township, Chester County, Pa. App. filed June 22, 1915. Applies particularly to apparatus for switching or controlling heavy electric currents such as are used in electric lighting and electric power practice.

1,251,302. Electric Recovery of Metals from Their Solutions; Urlyn C. Tainton, Johannesburg, Transvaal, South Africa. App. filed July 6, 1915. Improvements.

1,251,312. Cigar and Cigarette Lighter; Martha Wenzel, Jacksonville, Fla. App. filed Jan. 3, 1917. Improvements.

1,251,314. Ignition System; Ernest C. Wilcox, Meriden, Conn. App. filed Aug. 17, 1915. Relates to engines having a relatively large number of cylinders.

1,251,320. Telegraph Circuit-Closing and Signaling System; Frederick A. Anderson, Portage la Prairie, Man., Canada. App. filed March 2, 1917. Improvements.

1,251,350. Telephone System; Gerald Deakin, San Francisco, Cal. App. filed May 13, 1912. Automatic.

1,251,363. Signaling System; Bancroft Gherardi, Bayhead, N. J. App. filed Aug. 31, 1915. In connection with telephone systems.

1,251,364. Signaling System for Multiplex Telephone Circuits; Bancroft Gherardi, Bayhead, N. J. App. filed Nov. 24, 1916. Improvements.

1,251,365. Permutation Lock; William C. Gilmore, Chicago, Ill. App. filed May 25, 1917. Capable of manipulation from a distant point.

1,251,366. Thermo-Electric Fire-Alarm System; Abilio M. Da S. Greaves, Cambridge, Mass. App. filed June 11, 1914. Thermostatic circuit closer.

1,251,377. Method of and Means for Obtaining Constant Direct-Current Potentials; Albert W. Hull, Schenectady, N. Y. App. filed Dec. 22, 1915. Improvements.

1,251,378. Crystalline or Like Detector for Electric Waves; Horace Hurm, Paris, France. App. filed April 12, 1917. Consists in replacing the single contact by a device with multiple but independent contacts distributed over the surface of the detector substance employed.

1,251,388. Method of and Apparatus for Controlling X-Ray Tubes; Irving Langmuir, Schenectady, N. Y. App. filed Oct. 29, 1913. Improvements.

1,251,411. Electric Heater; James O'Connor, New York, N. Y. App. filed June 28, 1916. Immersion.

1,251,412. Secondary Storage Battery and Method of Making the Same; Charles S. Palmer, Newtonville, Mass. App. filed July 23, 1915. In which the electrolytic remains substantially constant in strength and action for prolonged periods of time owing to the auto-regeneration of the battery.

1,251,416. Insulator; Benjamin S. Purkey, Tacoma, Wash. App. filed May 4, 1914. Improved means for retaining an insulated wire in position.

1,251,419. Station Indicator; Earle H. Reynolds, Black Creek, N. Y. App. filed Nov. 9, 1915. For use in connection with street railways.

1,251,438. Insulator; Oscar O. Stone, San Antonio, Tex. App. filed May 31, 1917. For use in connection with water pipes.

1,251,440. Condenser Switch; Morton Sultzer, Brooklyn, N. Y. App. filed Dec. 20, 1915. Device by means of which the number of condenser elements present shall be materially reduced, but which will still permit of a complete step-by-step adjustment between certain limits of capacity.

1,251,446. Regulator; Louis W. Thompson, Wilkinsburg, Pa. App. filed March 22, 1913. For automatically regulating the effect of a resistance by intermittently short-circuiting the same.

1,251,452. Storage Battery; Irvine M. Noble and Walter E. Gossling, Indianapolis, Ind. App. filed Aug. 23, 1917. Covers for the cells of storage batteries.

(Issued Jan. 1, 1918)

1,251,472. Attaching Means for Ignition Breaker Boxes; William J. Brown, Newark, N. J. App. filed May 14, 1917. For use in connection with an inductor type of magneto.

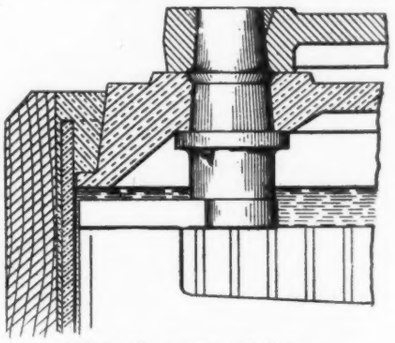
1,251,485. Process of Treating Sulphide Ores or Lead; Robert De Luce, Oakland, Cal. App. filed May 8, 1917. Hydrometallurgical process.

1,251,497. Floor Outlet Box; James M. G. Fullman, Pittsburgh, Pa. App. filed Nov. 17, 1908. Permits the ready insertion and removal of the receptacle.

1,251,504. Machine-Switching Telephone-Exchange System; Charles L. Goodrum, New York, N. Y. App. filed Aug. 23, 1915. Provides means associated with the connector for instantly applying current from a ringing generator to the called line when the connecter is set thereon.

1,251,505. Telephone-Exchange System; Charles L. Goodrum, New York, N. Y. App. filed Dec. 30, 1916. Improvements.

1,251,507. Current-Controlling Mechanism for Automobile Lights; Wilbur A. A. Gray, Canonsburg, Pa. Headlights.



1,251,452—Storage Battery

1,251,511. Process of Electrolytically Separating Nickel from Copper; George A. Guess, Oakville, Ontario, Canada. App. filed Aug. 14, 1917. A substantially insoluble reagent is employed which will react with copper sulphate to form an insoluble copper compound, and, preferably, an insoluble sulphate or a sulphate the presence of which in the electrolyte is not prejudicial.

1,251,516. Sign-Making Apparatus; Rudd Hardesty, Denver, Col. App. filed April 21, 1915. Improvements.

1,251,517. Automobile Signal; George L. Harris, Memphis, Tenn. App. filed Aug. 30, 1916. Improvements.

1,251,536. Telephone System; Charles W. Keckler, Newark, N. J. App. filed Nov. 16, 1915. House or intercommunicating systems.